RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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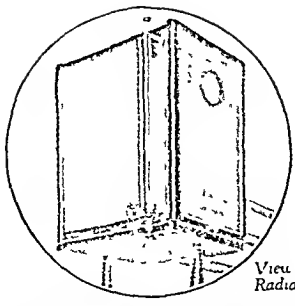
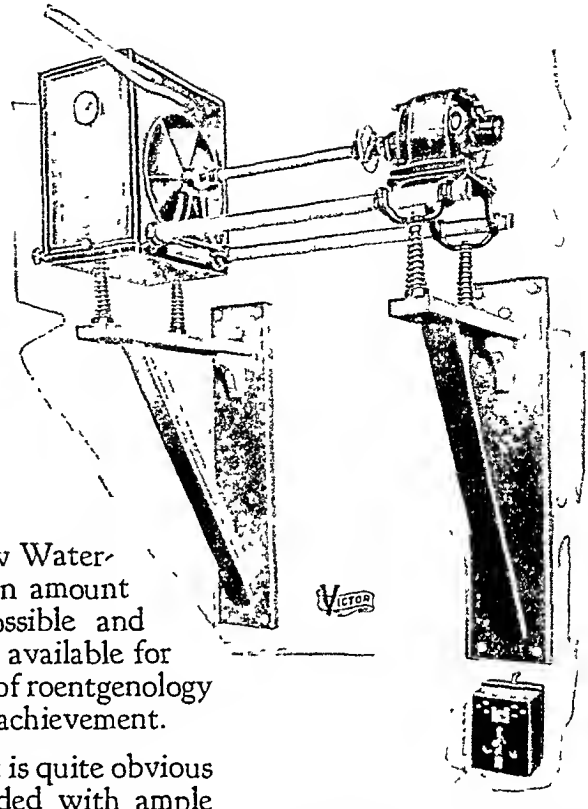


View from Radiator Side



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ROENTGEN CARDIAC STUDIES IN CHILDREN[1]

By C. WINFIELD PERKINS, M.D., NEW YORK CITY

THE essential points in early diagnosis of the more common types in chronic heart disease, according to Eyster, are as follows: "First, careful evaluation of etiology and symptomatology; second, general systematic routine physical examination; third, accurate percussion; fourth, comprehensive roentgen-ray examination in doubtful cases; fifth, the electro-cardiogram." The most neglected of the aids to diagnosis, Eyster believes, is the roentgen ray. My viewpoint is entirely sympathetic with the above statement, for, in scanning the literature, especially that which refers to the X-ray in the study of children cardiacs, the field has not been extensively explored and the literature is limited. It is the one method, however imperfect it may seem at present, that will at least give accurate knowledge of the form and contour of the heart, which knowledge cannot be obtained by any other method known at present and which is of definite value in arriving at a correct diagnosis.

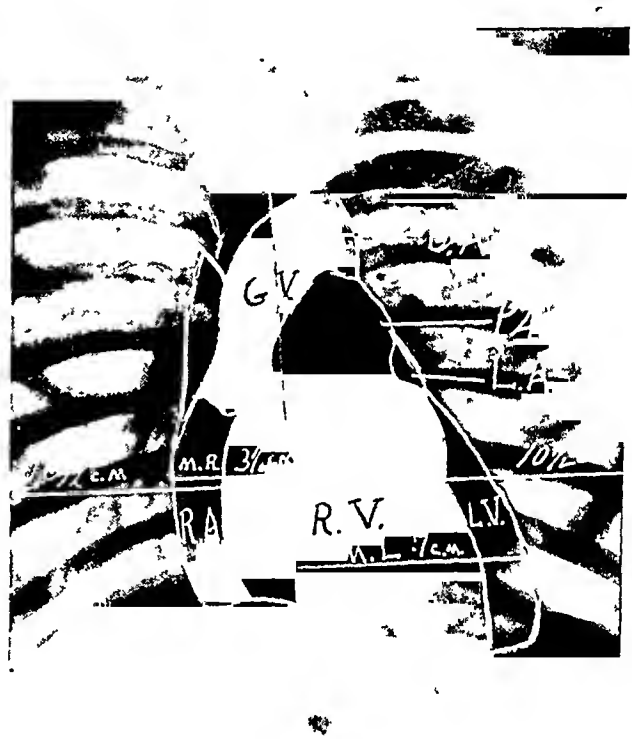

Fig. 1. Diagram, over a normal heart in a child aged nine years, taken at a distance of six feet. R. A., right auricle; R. V., right ventricle; L. V., left ventricle; L. A., left auricle; P. A., pulmonary artery; D. A., descending aorta; G. V., great vessels; M. R., middle right diameter; M. L., middle left diameter of the heart. M. R. 3 5 cm. plus M. L. 7 cm. equals 10.5 cm., which is one-half the diameter of the chest.

The fluoroscopic and roentgenographic method of diagnosis is of valuable assistance: First, in determining the size, shape, position and action of the heart in relation to the thorax; second, the condition of the heart muscle; third, the area of the heart involved; fourth, the relative location of the cardiac vessels; fifth, the possibility of congenital cardiac disease; sixth, the progressive changes in the cardiac muscle as demonstrated through subsequent examination; seventh, the presence or absence of pericardial fluid; eighth, the associated pulmonary pathology. The X-ray examination in many

[1]From the Cardiac Service, St. John's Guild and Seaside Hospital, New York Paper read before the Radiological Society of North America, Rochester, December, 1923.

instances not only substantiates a clinical diagnosis of cardiac disease. but in many instances amplifies the clinical findings.

Two methods of examination are essential for accurate X-ray findings,—the fluoroscope and the teleoroentgenograph combined. The fluoroscope has the advantage of making it possible to examine the patient at all angles and positions and aids much in visualizing the cardiac activity. and in determining the presence of fluid either in the pericardial sack or in the chest. It is of great value for the examination of the heart in young children. where plate work is difficult on account of the temperamental impulses of very young cardiac patients. The plate examination should be made at a distance of at least six feet. with the patient in the vertical posture. holding the breath on inspiration. In very young children. especially if they are restless. it is often necessary to make the exposures as soon as possible—when you can get them.—either on expiration or inspiration. In children under two years of age. in nearly all instances. it is necessary to make the exposures while the patient is lying down. and as rapidly as possible.

Comparative studies of the normal size. shape and position of the heart at all ages should be made. Observations which have been made on many children at the Seaside Hospital during the past three years. whose ages range from two months to fourteen years. have convinced me that the size and shape of the heart varies with the size and shape of the chest. For example, a broad-chested child will have a corresponding broad. globular heart. while a narrow-chested child will have an elongated type of heart.

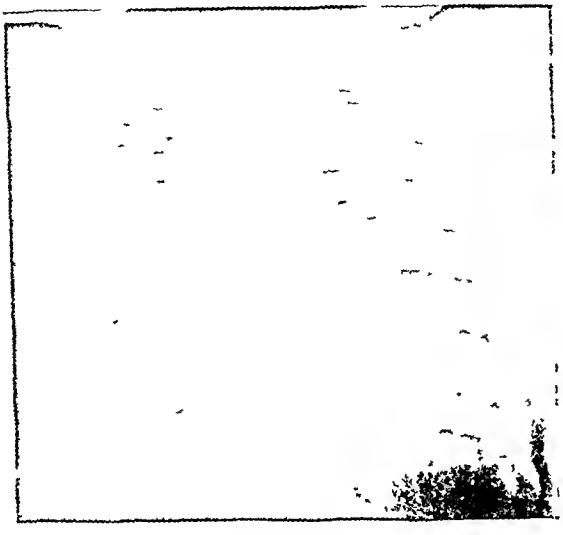

Fig. 2 Small normal heart of child aged eight years.

Fig. 3 Normal heart of child aged two and a half years.

Fig. 4 Congenital heart of infant aged three months. Note cloudiness of the upper right lobe.

Over two years ago, observations made on twenty-one normal hearts in children whose ages varied from two months to fourteen years, disclosed the fact that the transverse diameter of the heart through its widest part equals or approximates one-half the measurement of the chest in a corresponding position. Since that time I have had the opportunity of examining many more children at the same hospital, which observations have convinced me that this measurement of the heart is the most accurate one when used for comparative study.

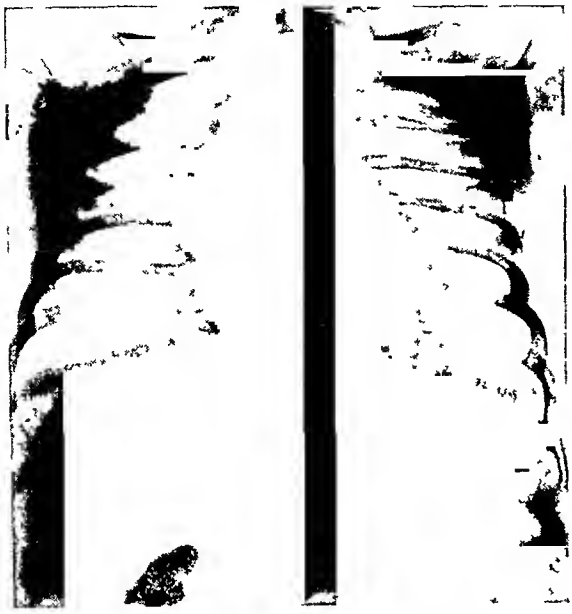

Fig 5 Normal heart of an infant aged three months

Fig. 7. Mitral stenosis and insufficiency in a child aged eight years Note pneumofibrosis in upper lobes of the lungs.

Fig 6 Double mitral disease, pan carditic heart, in a boy aged three years

Children under three years of age have a globular heart, which appears on X-ray examination to be larger than normal but on measurement corresponds with the above findings. The transverse measurement of the heart I believe to be the most important one in the roentgen examination of the normal or diseased heart. In the normal there is unquestionably variance in size—some smaller and others slightly larger—but as an average measurement the transverse or cardio-thoracic size offers, I believe, the best method that has yet been developed of ascertaining the capacity or size of the cardiac silhouette—and this applies to examination of children as well as mature individu

instances not only substantiates a clinical diagnosis of cardiac disease, but in many instances amplifies the clinical findings.

Two methods of examination are essential for accurate X-ray findings,—the fluoroscope and the teleoroentgenograph combined. The fluoroscope has the advantage of making it possible to examine the patient at all angles and positions and aids much in visualizing the cardiac activity, and in determining the presence of fluid either in the pericardial sack or in the chest. It is of great value for the examination of the heart in young children, where plate work is difficult on account of the temperamental impulses of very young cardiac patients. The plate examination should be made at a distance of at least six feet, with the patient in the vertical posture, holding the breath on inspiration. In very young children, especially if they are restless, it is often necessary to make the exposures as soon as possible—when you can get them,—either on expiration or inspiration. In children under two years of age, in nearly all instances, it is necessary to make the exposures while the patient is lying down, and as rapidly as possible.

Comparative studies of the normal size, shape and position of the heart at all ages should be made. Observations which have been made on many children at the Seaside Hospital during the past three years, whose ages range from two months to fourteen years, have convinced me that the size and shape of the heart varies with the size and shape of the chest. For example, a broad-chested child will have a corresponding broad, globular heart, while a narrow-chested child will have an elongated type of heart.

Fig. 2 *Small normal heart of child aged eight years*

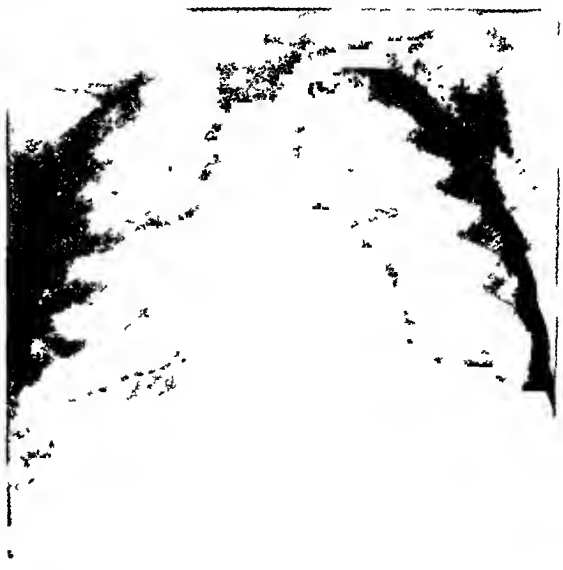

Fig 3 Normal heart of child aged two and a half years

Fig. 4 Congenital heart of infant aged three months. Note cloudiness of the upper right lobe.

however, much more pronounced in patients suffering from cardiac diseases.[2]

Congenital enlargement with its attending clinical symptoms has been at times con-

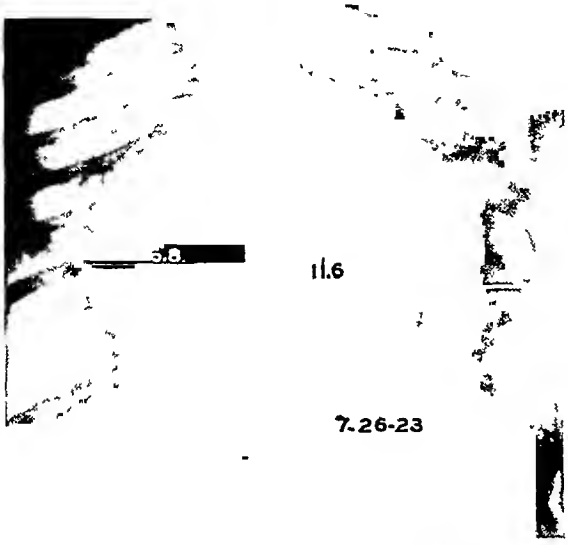

Fig. 11. Child twelve years old. Pan-carditic heart with myocardial degeneration and pericardial adhesions. This type of heart may easily be mistaken for one with effusion. Note narrow base in contrast to wide base of heart with effusion in pericardium.

fused with thymic enlargement, and it is only by the roentgen examination of the heart and chest that a diagnosis between these lesions can be made. Distortions of the heart and ascending aorta, resulting from imperfect technic in posturing the patient over the plate, should always be considered in making a diagnosis of cardiac and thymic disease.

CONGENITAL LESIONS OF THE HEART

This anomaly of the heart is, fortunately, infrequent. Without clinical findings and the history of the case, it would be impossible to make a definite diagnosis of any congenital lesion of the heart from the roentgenograph. In all the conditions the shadow of the heart is enlarged in the right auricular, left ventricular and pulmonic areas. Transposition of the great vessels and dextro-cardia, while rare and of interest as an anatomical curiosity, can be definitely demonstrated by the X-ray.

Mitral lesions are most frequently found in children, where, as a result of the valvu-

Fig. 12. Pericarditis with effusion, proven by aspiration, in boy aged twelve years. Note widened base and globular character of heart. It was possible in this roentgenograph to see cardiac shadow within the swollen sack on the large plate.

lar injury, there is marked dilatation with subsequent hypertrophy of the cardiac muscle. This naturally increases the transverse measurements of the heart in comparison with one-half the chest at the same position. If there is also associated mitral stenosis, as is very often the case, enlargement of the auricle is present. Aortic insufficiency and other valvular lesions occur with relative infrequency in young children. Kerley states that the ratio of aortic to mitral disease is about one in fifteen. In diseases of the myocardium it is important to consider the physical signs in conjunction with the plate findings and the fluoroscopic examination, which definitely visualizes the activity of the heart. The radiograph in these cases will show, at times, a very large globular heart with marked increase of the transverse diameter, and it is very necessary to differentiate this type of cardiac enlarge-

[2]Perkins and Hartshorn. N Y Med Journal and Med Record, March, 1923

Fig. 13. Enlarged pericardial sack, with moderate effusion, not aspirated. Marked orthopnea. Note widened base. Child thirteen years old. *Second exposure.* Same patient five weeks later, after treatment. Note narrow base and smaller heart shadow. Patient running about the ward.

ment from effusion in the pericardial sack. The X-ray is, I believe, of greater value in the diagnosis of pericarditis with effusion than it is given credit for being by eminent clinicians. I fear the discredit of much past work in the roentgen diagnostic field has been due to the over-enthusiasm and positiveness of the roentgenologists. Many roentgenologists, either through lack of training or over-enthusiasm for their work, fail to consider the clinical aspect of each case sufficiently. When there is a small

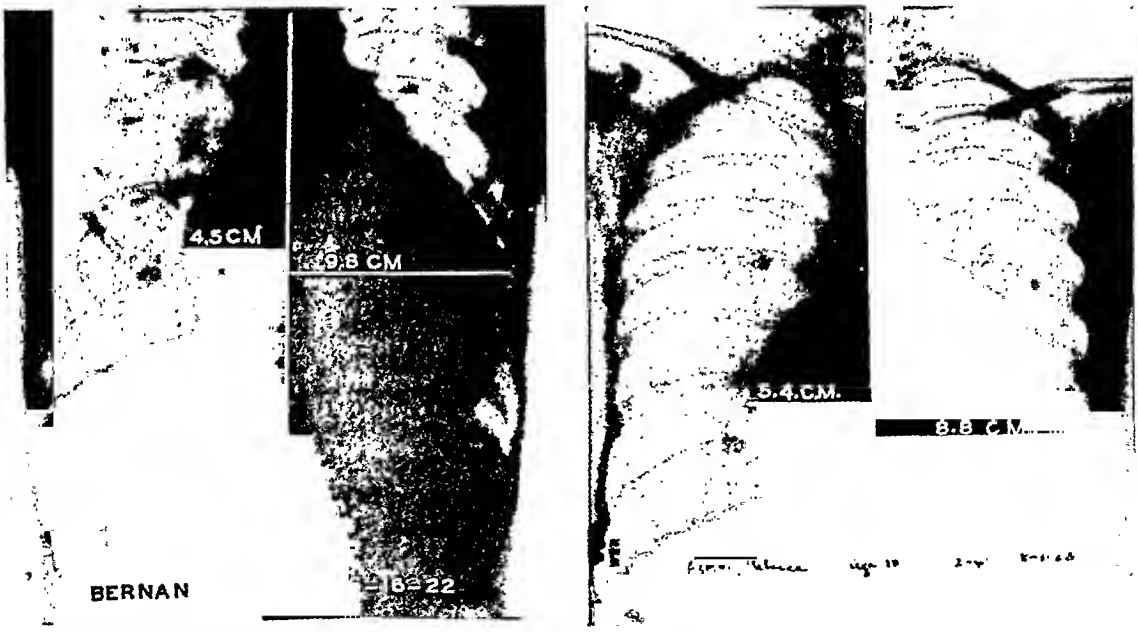

Fig. 14 *A.* Child thirteen years of age. Double mitral disease, with hypertrophy of left ventricle. Exposure made June 16, 1922. *B.* Same patient, one year later. Note change in character and size of heart shadow, especially the enlarged right auricular area.

amount of fluid in the pericardial sack it is a difficult matter, under any conditions, to make a diagnosis. In the differential diagnosis of pericarditis with effusion, from an enlarged heart, the change in contour of the shadow in position is, at times, the only positive sign in differentiating this malady from enlargement as a result of decompensation. There is always a possibility of visualizing the normal contour of the heart within the pericardial sack if fluid is present. This sign, however, is not possible of demonstration in every case.

The X-ray findings in pericarditis with effusion may be summed up as follows:

1. Heart globular in shape and enlarged symmetrically, with widened base.
2. Heart shadow larger in the recumbent posture than in the vertical position.
3. Diminished impulse of the heart under fluoroscopic examination. This is due to presence of sack fluid.
4. Visualizing the silhouette of the heart within the pericardial sack swollen with fluid.
5. The obliteration of the costo-cardiac angle, due to fluid in the pericardial sack, we feel is unreliable, as conditions of the pleura and lungs involving that region simulate distention and enlargement of the right heart.

From the X-ray study of 350 cases of cardiac disease during the past three summers at the Seaside Hospital, we have arrived at the following conclusions as to the value of the X-ray examination in assisting the diagnosis of cardiac diseases of children:

1. The roentgen examination in cardiac diseases of young children is of material aid in confirming physical signs.
2. It presents an accurate method of differentiating normal from abnormal hearts in children at different ages.
3. Progress of the disease may be noted by successive roentgen examinations.
4. At all ages in the normal, there is a constant ratio between the transverse diameter of the heart and the transverse diameter of the chest.
5. As a method of differentiating between congenital heart disease and the thymus gland disease it is invaluable.
6. Associated pathological conditions of the chest can be demonstrated.
7. Chronic cardiac disease is associated with pneumofibrosis, increased peribron-

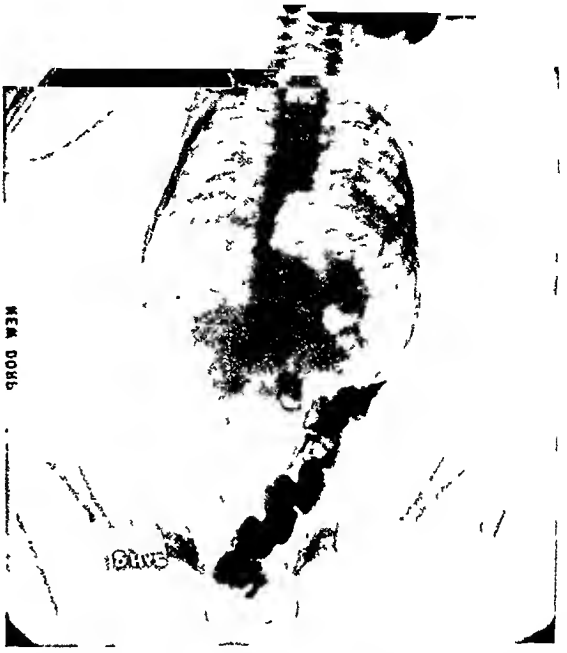

Fig. 15. Child six weeks old. Heart displaced to right due to herma of diaphragm. Large and small intestines in left chest.

chial shadows, fan-like in character, confined to the upper lobes of the lungs. This is verified in children as well as in the adult.

8. It offers valuable aid in differentiating cardiac enlargement from pericarditis with effusion.
9. Distortions in the shadow of the heart due to imperfect technic may simulate cardiac disease.
10. Successive exposures in X-ray examination should be taken in the same position at the same distance, on the same respiratory impulse (if possible), and identical time of exposure.

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MULTIPLE PRIMARY CARCINOMATA SIMULTANEOUSLY INVOLVING THE ALIMENTARY TRACT[1]

Case Report

By MAX KAHN, M.D., Baltimore, Maryland

MULTIPLE primary carcinomata of the alimentary tract are suffieiently uneommon to stimulate interest in a review of the literature. That sueh may exist in one or more organs has been proven by autopsies in some of the reported cases. In a thesis by Pierre Bernard, he eites,

Fig. 1. Filling defect of the esophagus with stenosis and dilatation 6 cm. above the cardia.

among a number of autopsies, that of a man, aged 77 years, who had primary eaneer of the esophagus and primary eancer of the ampulla of Vater. It is interesting to note that Billroth emphasized three faetors essential for the consideration of multiple primary carcinomata, namely: eaeh must be of a different histologieal structure; each must spring independently from epithelium of basie surface, aud each must make its own metastasis. These three conditions have been held too rigid by some authors. Ruben states as follows: "We have found the following statistics as to the frequency of multiple primary carcinomata. In 507 autopsies on patients dying with earcinoma, Feilchenfeld found not less than 10, or 2 per eent, with multiple primary earcinomata; Hansemann in 1,000 autopsies found only 5, or 0.5 per eent; Redlich found the same percentage; in 711 eases, Riechelmann found only 2 cases, or 0.3 per cent. Still these figures show that the possibility of two different careinomata in the same patient is something the surgeon should bear in mind. With the exception of careinoma of both breasts, which is the most common of the multiple primary eareinomata, the surgeon seldom finds multiple primary tumors." Rosenbach cites the autopsy of a man, aged 65 years, in whom were found two primary carcinomata, one of the esophagus and the other a typieal adenomatous carcinoma of the pylorus. He concludes by stating that both formed metastases, ehiefly that of the esophagus.

While fulfilling one of the essential factors of Billroth but not entirely confined to the alimentary tract, M. Lannois and Paul Courmont give an instance of a case, reported by Kretz, of an endothelioma of the dura mater and a eaneer of the esophagus, with metastases to the femur, where were found two metastatic nuclei, the one coming from the endothelioma and the other from the esophageal eaneer. A. Renaud quotes Göttingen as to a ease of triple primary eaneers existing simultaneously, eonsisting of squamous-cell earcinoma of the pharynx, adeno-careinoma of the reetum, and medullary carcinoma of the stomaeh. Carman reports a case of double eareinomata of the eolon in a male, aged 54 years, in whom at operation were found careinoma of the descending eolon and car-

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923.

cinoma of the sigmoid. Both were visualized as filling defects in the roentgenogram. According to Hauser it is possible to have several types of carcinoma in one organ, and he found at autopsy in a case of cancer of the stomach, (a) mixed form of adenomatous and medullary carcinoma along the lesser curvature, (b) adenomatous medullary cancer with transition to scirrhus on the posterior wall near the greater curvature, (c and d) simple adenomatous cancer with transition to scirrhus on the lesser curvature near the cardia in two places separated by a small strip of sound membrane. Goetze reports a most unusual case of multiple carcinomata in a man, aged 75 years, in which he found six primary carcinomata in the alimentary tract, as follows: carcinoma of the stomach, carcinoma of the splenic flexure, carcinoma of the descending colon, carcinoma of the sigmoid, carcinoma of the rectum and papillary adenoma of the intestines. In addition, he found carcinoma of the prostate and metastatic carcinoma of the liver. We were unable to find any reported cases of multiple primary sarcomata of the alimentary tract, and rarely a single primary sarcoma.

Our case is that of a white female, married, aged 62 years. She was admitted to Bon Secours Hospital in the service of Dr. E. H. Gaither, July 1, 1919.

Family History.—Unimportant. No history of malignancy.

Past History. — No serious illness at any time. None of the specific infections. *Head*—Negative, excepting for a great deal of dental trouble. *Chest*—Heart and lungs negative. *Gastro-intestinal*—Appetite and digestion always poor. Great deal of gas for several years. No nausea or vomiting before present illness. No colic or jaundice. Bowels regular before present illness, now constipated. *Genito-urinary*—Nycturia 1 to 2 quarts last few months. No dysuria. Never noticed blood or pus in urine. Mother of seven children. Two miscarriages before last child was born. All living children in good health. One child died of mastoiditis. *Neurological*—Nervous disposition. No fainting spells or convulsions. No attacks of depression. *Extremities*—No joint or muscular trouble.

Fig. 2. Stenosis of the pylorus with the stomach markedly dilated containing the 24-hour barium meal. Practically no barium is to be seen in the small intestines.

No paralytic stroke. *Skin*—No skin disorder. *Habits* — Regular in regard to meals, diet, sleep and exercise. Likes hot coffee, soup, etc. *Weight* — 125 to 130 pounds.

Present Illness.—Had an attack of influenza last October and never felt strong and well since. About January 1, 1919, noticed slight choking sensation in chest and slight pain when swallowing food. It was hard to swallow solid food, like meat. Soon began vomiting food, or, as a rule, in a very few minutes after swallowing it. Always felt very sick and like fainting after straining in an attempt to vomit. Has no pain in stomach, but great deal of gas. Has lived on practically a liquid diet for the last two months. Has no difficulty in breathing. Is very constipated.

Physical Examination.—The patient is a markedly emaciated woman past middle age, looks weak and ill. No special discomfort at present. No cardiac or respiratory distress. Temperature normal. Pulse a little rapid. Respiration normal. *Blood pressure*—120 80. *Head and neck*—Normal contour, face symmetrical, lips and mucous membrane pale. Muscles of expression and mastication act normally. The pupils are of medium size, round and equal, and react to light and distance normally. No nystagmus. Oral sepsis. Throat negative. Ophthalmoscopic examination negative. No cervical lymphadenitis. Thyroid not visibly or palpably enlarged. *Thorax*—Bony structures quite prominent and symmetrical. Lung expansion fair. Vocal fremitus normal throughout. No changes in the percussion note except slight impairment at both apices. Slight emphysematous character to breath sounds. Occasionally fine crackle heard at both apices. No change in voice sounds. No increased retromanubrial dullness. *Heart*—Negative excepting for a soft short systolic blow heard at mitral area and not well transmitted. The radial vessels are distinctly thickened. Pulse equal and regular in rate, force and rhythm. *Abdomen*—Scaphoid contour, symmetrical, visible peristaltic waves over upper abdomen. No areas of tenderness. The pylorus is easily palpable as a cord-like affair the size of a man's finger and as long, and gradually shades off into the stomach. It is quite firm and easily movable. No other masses felt in the abdomen. Liver edge, spleen and kidneys not palpable. Liver and splenic dullness not increased. There is a hernia at right external abdominal ring. *Extremities*—Markedly undernourished. Strength poor. No sensory or motor disturbances. Deep reflexes all present and equal. No clonus. Babinski negative. *Skin*—No lesions; general pallor. *Glands*—No enlarged glands.

July 2, 1919.—An attempt to pass a stomach tube met obstruction about three-fourths length down. Several attempts were made and obstruction found at some point each time.

July 3, 1919.—Stool examination; small amount, dark color, well formed, very firm. No gross food particles, blood, pus, mucus or parasites. Microscopic—Negative. Guaiac negative. *Red blood count*—4,915,250. *Hemoglobin*—75 per cent. *White blood count*—3,100. Normal differential count. Blood Wassermann negative.

The roentgenoscopic study of the esophagus and gastro-intestinal tract revealed the following: *Esophagus*—The barium meal passes freely down the esophagus until about 6 cm. from the cardia, where there appears a definite stenosis with dilatation above. Some of the barium meal passes slowly by the obstruction as a slender shadow and passes to the cardiac end of the stomach, where again there appears some obstruction. The stomach in the erect position is large and atonic and prolapsed well into the pelvis. The pylorus has a somewhat abrupt cut-off appearance. It is difficult to force the barium meal past the pylorus. The duodenal bulb is visualized with the greatest difficulty by palpation and appears very small, and almost indistinct. Practically no barium is to be noted in the intestines at the end of twenty-four hours. There is a definite twenty-four hour gastric retention.

Impression—Organic lesion of the lower end of the esophagus and of the pyloro-duodenal region, in all probability carcinoma. Roentgenograms made of the esophagus and of the gastro-intestinal tract confirm the above findings. In addition there is to be noted lipping of the bodies of the dorsal vertebræ, suggestive of old hypertrophic arthritis.

The patient died from inanition nineteen days after admittance to the hospital, and, unfortunately, neither operation nor autopsy was permitted. A brief review of this case both clinically and roentgenologically leads us to believe that we were dealing with a case of multiple primary carci-

nomata, although we were unable to prove this either by operation or autopsy.

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DISCUSSION

Dr. William C. MacCarty (Rochester, Minnesota): In looking over my experience I find that primary multiple neoplasmata are extremely rare, although they do occur, as has been pointed out by Dr. Kahn. It seems strange that they do not occur more frequently. Among the conditions of many primary lesions which I can recall are carcinoma of the uterus associated with papillary carcinoma of both ovaries. There is a question, however, as to the one in the uterus being a transplantation from the one in the ovary.

I have seen carcinoma of the breast and carcinoma of the splenic flexure in the same individual, each carcinoma having different morphological characteristics.

Surgical material is not so likely to reveal multiple primary lesions as is that found in the autopsy room. I regret that time has not permitted me to tabulate for you all the multiple lesions which we have had in over 40,000 neoplasmata.

Dr. Max Kahn (closing): In reviewing the literature at the Library of the Surgeon General's Office at Washington I was astonished to find a number of cases of multiple primary carcinomata reported, not only of the alimentary tract but of other organs as well, chiefly by German, Austrian, French and a few Norwegian observers. Dr. MacCarty spoke about seeing cases of multiple primary carcinomata of the breast. These are not very common, but relatively more frequent. Billroth laid down three essential factors in the consideration of multiple primary neoplasms, stating: first, that each must be of a different histological structure; second, each must spring independently from epithelium of basic surface; third, each must make its own metastasis. These three conditions have been held too rigid by some observers, and in this review we have found several cases that fulfilled all of these conditions, but most of them only two. At the time our case came under observation I did not recall having seen cases of multiple primary carcinomata reported in the literature at our command, and it stimulated us to look up the subject and see how much there was written on it.

Physical Examination.—The patient is a markedly emaeiated woman past middle age, looks weak and ill. No special discomfort at present. No eardiac or respiratory distress. Temperature normal. Pulse a little rapid. Respiration normal. *Blood pressure*—120/80. *Head and neck*—Normal eontour, faee symmetrieal, lips and mueous membrane pale. Muscles of expression and mastieation aet normally. The pupils are of medium size, round and equal, and reaet to light and distanee normally. No nystagmus. Oral sepsis. Throat negative. Ophthalmoseopic examination negative. No cervical lymphadenitis. Thyroid not visibly or palpably enlarged. *Thorax*—Bony structures quite prominent and symmetrical. Lung expansion fair. Vocal fremitus normal throughout. No changes in the percussion note except slight impairment at both apices. Slight emphysematous eharaeter to breath sounds. Oecasionally fine erackle heard at both apiees. No change in voiee sounds. No incrcased retromanubrial dullness. *Heart*—Negative exeepting for a soft short systolic blow heard at mitral area and not well transmitted. The radial vessels are distinctly thiekened. Pulse equal and regular in rate, force and rhythm. *Abdomen*—Scaphoid eontour, symmetrieal, visible peristaltic waves over upper abdomen. No areas of tenderness. The pylorus is easily palpable as a cord-like affair the size of a man's finger and as long, and gradually shades off into the stomach. It is quite firm and easily movable. No other masses felt in the abdomen. Liver edge, spleen and kidneys not palpable. Liver and splenic dullness not inereased. There is a hernia at right external abdominal ring. *Extremities*—Markedly undernourished. Strength poor. No sensory or motor disturbanees. Deep reflexes all present and equal. No clonus. Babinski negative. *Skin*—No lesions: general pallor. *Glands*—No enlarged glands.

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of a grouping of the various endocrine disorders, both of which precepts are very difficult and probably can not be established beyond criticism. Before accepting individuals as normals for the various ages, they were carefully examined clinically and roentgenologically. The clinical examination consisted of investigating the family history, particularly for endocrine and hereditary conditions, including blood examinations of the parents. A complete medical survey of each individual, including comparison for the height, weight and age with the normal (established by tables of Browning, Bowditch and Holt for infants and children and insurance tables for adults) was then made. Provided the individual was considered normal according to these qualifications (i.e., family history, personal history, physical examination, and standard tables) he was then X-rayed and the roentgenological findings were compared with those for the various ages as given by Gray's Anatomy and the radiological studies of Baetjer and Waters, Knox, and Rotch. Decided variations, with personal exceptions enumerated in the following charts, in the roentgenological determinations of the osseous system from those already considered within the normal by these four authorities were excluded as possible normals. Normals were examined 8 to 10 days after birth, at 6 months, 1 year, 18 months, 2 years, and for each year up to the age of 25. A number of each age were examined until enough were found without physical or roentgenological variations from the normal to establish a standard. This work presented a great many difficulties and required a long time in order to exclude the abnormals physically and then finally to determine the roentgenological normal. The four authorities quoted above giving normals for the various ages differed considerably in their opinions upon certain osseous developments as displayed by the roentgenogram, as shown by Charts I to VII.

Chart I
UPPER EXTREMITY (GRAY'S ANATOMY)

BONES	APPEARANCE OF OSSIFICATION CENTERS	UNION
Humerus 8 centers	Shaft: 5th wk. fetal life. Head: 1st yr. Greater tubercle: 3rd yr. Lesser tubercle: 5th yr. Capitellum: End of 2nd yr. Medial epicondyle: 5th yr. Lateral epicondyle: 13th to 14th yr.	Head and tuberoles: 6th yr. Upper epiphysis with body: 20th yr. Lower epiphysis with body: 18th yr.
Ulna 3 centers	Body: 8th wk. fetal life. Head (inferior extremity): 4th yr. Olecranon: 10th yr.	Upper epiphysis: 16th yr. Lower epiphysis: 20th yr.
Radius 3 centers	Body: 8th wk. fetal life. Lower epiphysis: 2nd yr. Upper epiphysis: 5th yr.	Upper epiphysis: 17th to 18th yr. Lower epiphysis: 20th yr.
Carpal bones 1 center for each	Capitate: 1st yr. Hamate: 1st yr. Triangular: 3rd yr. Lunate: 5th yr. Greater multangular: 5th yr. Navicular: 6th yr. Lesser multangular: 8th yr. Pisiform: 12th yr.	
Metacarpals 2 centers	Body: 8th wk. fetal life. Distal extremity: 3rd yr. Base of thumb metacarpal: 3rd yr.	20th yr.
Phalanges 2 centers	Body: 8th wk. fetal life. Proximal extremity:- 1. First row: 3rd to 4th yr. 2. Second and third rows: 4th to 5th yr.	18th to 20th yr.

In order to obtain some estimation of the roentgenological findings of the varic·

OSSEOUS DEVELOPMENT IN ENDOCRINE DISORDERS[1]

By WM. ENGELBACH, M.S., M.D., Professor of Clinical Medicine, St. Louis University School of Medicine, and ALPHONSE McMAHON, A.B., M.D., Assistant in Medicine, St. Louis University School of Medicine, St. Louis, Mo.

THE striking variations of stature in the eunuch, the acromegalic, and the various types of infantilism have been of historical interest even to the layman. An illustration of this interest is the prize offered by the philanthropist for the intermarriage of giants in order to produce a larger and stronger race. These objective differences in size and local osseous proportions of the individual were among the first signs giving impetus to the scientist to study the harmonic effects of the internal secretions upon skeletal growth. C. v. Langer (1872) was probably the first to distinguish between pathological and normal giants. To Pierre Marie (1888-89), Massalongo (1892), Sternberg (1895), Brissaud and Meige (1895), and Launois and Roy (1902-04) credit should be given for the earliest work relating the development of the osseous system in gigantism and acromegaly to the hypophysis. Tandler and Grosz (1907-10) in their studies of the skopzen directly associated the overgrowth of the long bones present in the early hypogonad states to castration.

These early investigations, besides indicating a general change in the osseous system present in various ductless gland disorders, were pointing the way to local osseous abnormalities in the growth and development of individual bones as related to special glandular function. Soon after the discovery of the X-ray, roentgenology was applied with more minutiæ to determine in the living the development of the osseous nuclei and the closure of the epiphyseal ends, which clinical deduction had predicted would vary in the endocrine subjects from those of the normal. Hertoghe (1896), v. Wyss (1899-1900), Kasowitz (1902), Diederle (1906), Siegert (1910), and others were the first to demonstrate by this means the presence of retarded carpal development in juvenile hypothyroidism.

In a clinical material of over 2,000 endocrine observations,[2] the striking differences in the osseous development, general and local, led the writers to suspect that there might be some specific predilection of the various hormones of special ductless glands in their effect upon the growth and development of the individual types of bones; i.e., short, flat, or long bones. This led to the following studies, which were undertaken to determine: (1) the normal osseous development in the various ages from 1 to 25, during the skeletal growth; (2) the variations from this normal development in the various endocrine disorders, viz., thyroidism, pituitarism, gonadism, pinealism, thymolymphatism, pluriglandularism, etc.; and (3) the possible specific character of the internal secretions of these various glands in their effect upon the individual growth of one set of bones, such as the flat, long, or short. If such specific osseous hormone effects are presented, or even if definite general osseous changes, recognizable by roentgenograms, do occur in some of these endocrine disorders, they would be of great value in the early diagnosis of the disorders of the glands, as well as a specific measure of their function and the treatment effects of these dyscrasias. These studies apply only to the age of 25, at which time the osseous development is normally completed.

In order to draw any convincing conclusions from these comparisons, it was first necessary to determine a normal for each age and then to agree upon the definition

[2]Clinical observations of this material were made with Dr. J. L. Tierney.

[1]Address delivered at annual meeting of the Radiological Society of North America, at Rochester, Minn., Dec. 5, 1923.

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of a grouping of the various endocrine disorders, both of which precepts are very difficult and probably can not be established beyond criticism. Before accepting individuals as normals for the various ages, they were carefully examined clinically and roentgenologically. The clinical examination consisted of investigating the family history, particularly for endocrine and hereditary conditions, including blood examinations of the parents. A complete medical survey of each individual, including comparison for the height, weight and age with the normal (established by tables of Browning, Bowditch and Holt for infants and children and insurance tables for adults) was then made. Provided the individual was considered normal according to these qualifications (i.e., family history, personal history, physical examination, and standard tables) he was then X-rayed and the roentgenological findings were compared with those for the various ages as given by Gray's Anatomy and the radiological studies of Baetjer and Waters, Knox, and Rotch. Decided variations, with personal exceptions enumerated in the following charts, in the roentgenological determinations of the osseous system from those already considered within the normal by these four authorities were excluded as possible normals. Normals were examined 8 to 10 days after birth, at 6 months, 1 year, 18 months, 2 years, and for each year up to the age of 25. A number of each age were examined until enough were found without physical or roentgenological variations from the normal to establish a standard. This work presented a great many difficulties and required a long time in order to exclude the abnormals physically and then finally to determine the roentgenological normal. The four authorities quoted above giving normals for the various ages differed considerably in their opinions upon certain osseous developments as displayed by the roentgenogram, as shown by Charts I to VII.

In order to obtain some estimation of the roentgenological findings of the various

Chart I
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Humerus 8 centers	Shaft: 5th wk. fetal life. Head: 1st yr. Greater tubercle: 3rd yr. Lesser tubercle: 5th yr. Capitellum: End of 2nd yr. Medial epicondyle: 5th yr. Lateral epicondyle: 13th to 14th yr.	Head and tubercles: 6th yr. Upper epiphysis with body: 20th yr. Lower epiphysis with body: 18th yr.
Ulna 3 centers	Body: 8th wk. fetal life. Head (inferior extremity): 4th yr. Olecranon: 10th yr.	Upper epiphysis: 16th yr. Lower epiphysis: 20th yr.
Radius 3 centers	Body: 8th wk. fetal life. Lower epiphysis: 2nd yr. Upper epiphysis: 5th yr.	Upper epiphysis: 17th to 18th yr. Lower epiphysis: 20th yr.
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Metacarpals 2 centers	Body: 8th wk. fetal life. Distal extremity: 3rd yr. Base of thumb metacarpal: 3rd yr.	20th yr.
Phalanges 2 centers	Body: 8th wk. fetal life. Proximal extremity:- 1. First row: 3rd to 4th yr. 2. Second and third rows: 4th to 5th yr.	18th to 20th yr.

ages, the individual bones of the body were first classified from an anatomical viewpoint, as given by Gray's Anatomy, Charts I and II.

The bones according to the appearance of centers of ossification and union of the epiphyses for the yearly ages were then *arranged by years* according to Gray's Anatomy (Chart III).

The appearance and union of the centers of various bones of the body were then compared, according to Gray's Anatomy and the roentgenographic studies of Baetjer and Waters and of Knox (Charts IV and V).

This information was rearranged as to yearly appearance and union of the centers of ossification, according to Gray's Anatomy, Baetjer and Waters, Knox, and Rotch (Charts VI and VII).

It will be noted that there are variations of two to four years in the roentgenographic studies of Baetjer and Waters, Knox, and Rotch and the dissection made by the anatomists. For instance the anatomist gives the union of the lower epiphysis of the femur at the age of 20, while Baetjer and Waters state that this epiphyseal line disappears at 18 to 20. The heads of the metacarpals are given by Gray's Anatomy as completely united at 20, by Baetjer and Waters at 17 to 18, by Knox at 18, and, according to our normals, in all instances at 14 to 15. Other variations will be noted in almost every age. It occurred to us that possibly the anatomist, pediatrician (Rotch), and radiologist (Baetjer and Waters) did not consider the endocrine possibilities in their so-called normals. This might explain the marked variability in age of the appearance of the centers of ossification and the fusion of the epiphyseal lines, as well as the general variations in the growth of the various bones.

After carefully interpreting this work and comparing with the normal that we had observed for the various ages, we have finally established the table above (Chart VIII), which is a compilation of our own studies and those of the other authors. In

Chart II
LOWER EXTREMITY (GRAY'S ANATOMY)

BONES	APPEARANCE OF OSSIFICATION CENTERS	UNION
Os coxae 8 centers	Primary:- 1. Ilium: 8th wk. fetal life. 2. Ischium: 3rd mo. 3. Pubic: 5th mo. Secondary:- 1. Crest of ilium) 2. Antero-inferior spine) 3. Tuberosity of ischium) - puberty. 4. Pubic symphysis) 5. Acetebulum)	Ilium) Ischium) 18th yr. Pubis) Secondary and primary centers: 20th to 25th yr.
Femur 5 centers	Body: 7th wk. fetal life. Head: End of 1st yr. Greater trochanter: 4th yr. Lesser trochanter: 13th to 14th yr. Lower epiphysis: 9th mo. fetal life.	All united after puberty in reverse order of their appearance. Lower epiphysis at 20th yr.
Patella 1 center	2nd to 3rd yr. Complete at puberty.	
Tibia 3 centers	Body: 7th wk. fetal life. Upper epiphysis: 2nd yr. Lower epiphysis: 2nd yr.	Lower with body: 18th yr. Upper with body: 20th yr.
Fibula 3 centers	Body: 8th wk. fetal life. Lower epiphysis: 2nd yr. Upper epiphysis: 4th yr.	Lower with body: 20th yr. Upper with body: 25th yr.
Tarsus 7 centers	Calcaneus: 6th mo. fetal life. Talus: 7th mo. fetal life. Cuboid: 9th mo. fetal life. 3rd cuneiform: 1st yr. 1st cuneiform: 3rd yr. 2nd cuneiform and navicular: 4th yr.	
Metatarsals 2 centers	Body: 9th wk. fetal life. Base of first metatarsal: 3rd yr. Heads of second, third, fourth, and fifth: 5th to 8th yr.	18th to 20th yr.
Phalanges 2 centers	Body: 10th wk. fetal life. Base: 4th to 10th yr.	18th yr.

this article in referring to the normal, we use the osseous developments as given in the above table (Chart VIII). In order to make this work practicable and applicable to the average X-ray technician, we have devised a table (Chart IX) giving the parts to be X-rayed in individuals of various ages. On account of the marked variations for each age, it is unnecessary to refer to the fact that, unless roentgenograms are taken of special bones for an individual age, the most important evidence referable to the osseous development for that age will not be obtained. It has been our custom in these cases to take roentgenograms of the bones given under the years before and after the age of the patient. For instance, for a patient who is nearest the tenth birthday, roentgenograms of the special parts given under the ages of 9, 10 and 11 in Chart IX should be made for comparison with the normal for those ages.

Chart III

NORMAL OSSIFICATION AND UNION OF EPIPHYSES FOR YEARLY AGES (GRAY'S ANATOMY)

YEARS	APPEARANCE AND UNION OF CENTERS	YEARS	APPEARANCE AND UNION OF CENTERS
Birth	Shafts of long and short bones. Calcaneus, talus, cuboid, third cuneiform (tarsals).	10	Olecranon (ulna).
1	Head of humerus. Head end distal epiphysis of femur. Capitate and hamate (carpels).	12	Pisiform (carpal).
2	Radius, lower epiphysis. Tibia, lower epiphysis. Fibula, lower epiphysis. Patella.	13 to 14	Lateral epicondyle of humerus. Lesser trochantar of femur.
3	Greater tubercle of humerus. Triangular (carpal). Heads of metacarpals. Bases of phalanges (hand), first row. First cuneiform (tarsal). Bases of metatarsals.	16	Upper epiphysis of ulna with body.
4	Head of ulna. Bases of phalanges (hand), second and third rows. Greater trochanter of femur. Upper epiphysis of fibula. Second cuneiform and navicular (tarsals). Bases of phalanges (foot) - 4th to 10th yr.	17	Upper epiphysis of radius with body.
5	Lesser tubercle of humerus. Medial epicondyle, humerus. Upper epiphysis of radius. Lunate end greater multangular (carpals). Heads of metatarsals - 5th to 8th yr.	18	Centers of femur. Lower epiphysis of humerus with body. Bases and bodies of phalanges (hands and feet). Lower epiphysis of tibia with body. Heads and bodies of metatarsals.
6	Navicular (carpal). Union of head of humerus with tubercles.	20	Upper epiphysis of humerus. Lower epiphysis of ulna. Lower epiphysis of radius. Heads and bodies of metacarpals. Lower epiphysis of femur. Upper epiphysis of tibia. Lower epiphysis of fibula.
8	Lesser multangular (carpal).	25	Upper epiphysis of fibula.

COMPARISON OF NORMALS WITH ENDOCRINOPATHIC SUBJECTS OF THE SAME AGE

Birth to the age of 1. The normal infant (Fig. 1) shows the centers for the distal epiphysis of the femur, proximal epiphysis of the tibia, and three tarsal bones, the talus, cuboid, and calcaneus. There is an absence of all carpals and heads of metacarpals and phalanges. The presence at birth of the center for the upper epiphysis of the tibia is not generally admitted by all authorities. At the age of 1 there are normally two carpal centers present, the capitate and hamate. The head of the humerus, head of the femur, and third cuneiform appear within the first year. The absence of the capitate and hamate is particularly valuable in the diagnosis of early hypothyroid states. The diagnosis can thus be made at a time when material assistance can be rendered the child in the progress of normal development. For this reason, in the obstetrical department of St. John's Hospital, St. Louis, a routine radiographic examination of all infants 10 days after birth, with successive radiographs taken at intervals of six months, is encouraged. This allows a study of the develop-

ment of the osseous system, permitting an earlier diagnosis of endocrine disorders.

Aged 2. The three pictures of Fig. 2 illustrate the effect of thyroid treatment upon the osseous development in hypothyroidism in infancy. No. 1 shows the hand of a hypothyroid child at 26 months, one carpal bone, the capitate, being present. Normally at this age there should be two carpal bones, the capitate and hamate, well developed. There is also absence of the center for the lower epiphysis of the radius, which normally appears in the second year. Other important centers occurring within the second year are the greater tubercle of the humerus, capitellum, patella, lower epiphyses of the tibia and fibula, and first and second cuneiforms, these last two appearing from 2 to 4 years. No. 2 demonstrates the effect of the administration of thyroid substances upon the osseous development. At 41 months there are four carpal bones present, together with the head of the radius. The carpal bones are slightly undeveloped, with the os triangularis and lunate of about equal size. No. 3 shows the same subject at 56 months. There has been definite progression in the development of the carpal bones and the head of the radius. The center for the head of the first metacarpal is also present. This hand is practically normal for the age. Fig. 3 is a comparison of the same hypothyroid hand after treatment. The progress of the osseous development of the hand is noted in all epiphyseal centers, particularly in the heads of the metacarpals and phalanges. The previous figure shows the absence of many centers in the phalanges at 41 months.

Aged 2 years, 10 months. Fig. 4 is a demonstration of an enlarged thymus, with underdevelopment of the carpal bones and absence of the head of the radius. Normally at this age there should be three carpal bones present. The os triangularis is absent. Centers for some metacarpals are just appearing, which is within the normal. The heads of the phalanges are absent, these normally appearing within the third year.

Chart IV

APPEARANCE AND UNION OF BONE CENTERS, UPPER EXTREMITY, ACCORDING TO

BONES	GRAY'S ANATOMY		BAETJER AND WATERS		KNOX	
	APPEAR	UNITE	APPEAR	UNITE	APPEAR	UNITE
Scapula						
1.Acromion (2 cent.)	15th-16th	25th	15th	18th	15th-17th	22nd-25th
2.Coracoid (" ")	1st-17th	"	1st	15th	1st and 15th-17th	15th
3.Inferior angle	16th	"	15th	18th	15th-17th	22nd-25th
Clavicle						
1.Sternal end	18th-20th	25th	15th-17th	23rd-25th	18th-20th	25th
Humerus						
1.Head	1st	Head & tubercles,6th.	6th-7th mo.	6th	1st	5th
2.Greater tubercle	3rd		3rd-4th yr.	"	3rd	"
3.Lesser "	5th	Head & shaft, 20th.	" "	"	5th	" Head and shaft,20th.
4.Capitellum	2nd	4,5,6 & 7: Unite with shaft at 18th yr.	1st	18th-19th	2nd	16th-18th
5.Medial epicondyle	5th		5th	"	5th	"
6.Trochlea	12th		10th-11th	"	12th	"
7.Lateral epicondyle	13th-14th		12th-14th	"	13th-14th	"
Ulna						
1.Lower epiphysis	4th	20th	4th	18th	4th	20th
2.Olecranon	10th	16th	8th-9th	17th	10th	16th
Radius						
1.Lower epiphysis	2nd	20th	2nd	17th-18th	2nd	20th
2.Upper "	5th	17th-18th	5th	16th-17th	5th	17th-18th
Carpal Bones						
1.Capit. (os magnum)	1st		1,2,3,4,5, 6 & 7: Appear in anatomical order,one bone for each year.		1,2,3,4,5, 6,7 & 8: Appear in anatomical order.	
2.Hamate (unciform)	"					
3.Triang.(cuneiform)	3rd					
4.Lunate (semilunar)	5th					
5.Gr.mult.(trapezium)	"					
6.Navicular(scaphoid)	6th					
7.Less.mult.(trapezoid)	8th					
8.Pisiform(pisiform)	12th		8.8th-11th			
Metacarpals						
1.Digital extremity	3rd	20th	3rd	17th-18th	3rd	18th
2.Base of 1st	"	"	"	"	"	"
Phalanges						
1.Head, 1st row	3rd-4th	18th-20th	3rd	16th-17th	3rd-4th	18th-20th
2. " 2nd and 3rd rows	4th-5th	"	"	"	4th-5th	"

Chart V

APPEARANCE AND UNION OF BONE CENTERS, LOWER EXTREMITY, ACCORDING TO

BONES	GRAY'S ANATOMY		BAETJER AND WATERS		KNOX	
	APPEAR	UNITE	APPEAR	UNITE	APPEAR	UNITE
Os Coxae						
1.Prim.centers						
a.Ilium	Birth	18th	Birth	15th-16th	Birth	18th
b.Ischium	"	"	"	"	"	"
c.Pubis	"	"	"	"	"	"
		P & I,7th-8th		P & I,7th-9th		P & I,7th-8th
2.Sec.centers						
a.Ant.-inf.sp.	Puberty	20th-25th	15th	20th	Puberty	25th
b.Tub.ischium	"	"	"	"	"	"
c.Pubic symph.	"	"	"	"	"	"
d.Crest ilium	"	"	15th-18th	23rd-25th	"	"
e.Acetebulum	"	"	15th-16th	15th-16th	"	"
Femur		1, 2 and 3:				1, 2 and 3:
1.Head	End of 1st	Reverse order	End of 1st	17th-18th	End of 1st	Reverse order
2.Greater troch.	4th	of appearance,	4th	18th	4th	of appearance,
3.Lesser "	13th-14th	after puberty.	11th-13th	17th	13th-14th	after puberty.
4.Lower epiph.	9th mo.fet. life	4. 20th	Birth	18th-20th	9th mo.fet. life	4. 20th
Patelle	2nd-3rd		3rd-4th		3rd	
Tibia						
1.Upper epiph.	2nd	20th	1st	18th-20th	Birth	20th
2.Lower "	"	18th	2nd	17th-18th	2nd	18th
Fibula						
1.Upper epiph.	4th	25th	3rd-4th	18th-25th	4th	25th
2.Lower "	2nd	20th	2nd	17th-18th	2nd	20th
Tarsus						
1.Calcaneus (os calcis)	6th mo.fet. life	Cent.for epiphysis os calcis at 10th yr. and unites after puberty.	Bef.birth	Cant.for epiphysis os calcis appears at 10th yr. and unites at 18th.	6th mo.fet. life	Cent.for epiphysis os calcis appears at 10th yr. and unites after puberty.
2.Talus (astragalus)	7th mo.fet. life		"		7th mo.fet. life	
3.Cuboid(os cuboideum)	9th mo.fet. life		"		9th mo.fet. life	
4.3rd cuneiform (external)	1st		1st		1st	
5.1st (internal)	3rd		3rd		3rd	
6.2nd (middle)	4th		4th		4th	
7.Navicular (scaphoid)	"		"		"	
Metatarsals						
1.Base of 1st	3rd	18th-20th	3rd-7th	About 17th	3rd	18th-20th
2.Heads of 2nd to 5th	5th-8th	"	"	"	"	"
Phalanges						
1.Bases	4th-10th	18th	3rd-7th	17th	Not given	

Chart VI

No. 1 APPEARANCE AND UNION OF BONE CENTERS BY YEARS, ACCORDING TO

Yrs.	GRAY'S ANATOMY	HAETJER AND WATERS	KNOX	ROTCH
1	Coracoid proc.scapula Head humerus Capitata & hamate Head femur (birth) 3rd cuneiform	Coracoid proc.scapula Head humerus (6-7 mos.) Capitallum,humerus Capitata & hamate Head femur Upp.epiph.tibia 3rd cuneiform	Coracoid proc.scapula Head humerus Capitate & hamate Head femur Upp.epiph.tibia 3rd cuneiform	Head humerus(6-8 mos.) Capitellum,humerus (2-3) Capitate & hamate Head femur Upp.epiph.tibia(birth)
2	Capitallum,humerus Low.epiph.radius Patella (2-3) Upp.epiph.tibia Low.epiph.tibie Low.epiph.fibula	Low.epiph.radius Low.epiph.tibia Low.epiph.fibula	Capitellum,humerus Low.epiph.radius Low.epiph.tibia Low.epiph.fibula	Low.epiph.radius(2-4) Patella (2-3) Low.epiph.tibia(12th mo.-2nd yr.) Low.epiph.fibula(2-3)
3	Gr.tubarcle humerus Os triangularis Heads metacarpals Heads prox.phalang(3-4) 1st cuneiform Hsads metatarsals(3-8)	Gr.tuber.humerus(3-4) Os triangularis Hsads metacarpals Hsads phalanges Patella (3-4) 1st cuneiform Heads metatarsals (3-7)	Gr.tubercle humerus Os triangularis Heads metacarpals Hsads prox.phalang(3-4) Patella 1st cuneiform Hsads metatarsals	Tubercelitas humerus (2-3) Os triangularis(2-3) Hsads metacarpals Hsads phalanges(3-4) 1st cuneiform Hsads metatars.(3-8)
4	Low.epiph.ulne Heads phelangas, 2nd & 3rd rows Gr.troch.famur Upp.epiph.fibula 2nd cuneiform Navicular (tarsal)	Low.epiph.ulna Gr.troch.famur Upp.epiph.fibula (3-4) 2nd cuneiform Navicular (tarsal)	Low.epiph.ulna Hsads 2nd & 3rd phalanges Gr.troch.famur Upp.epiph.fibula 2nd cuneiform Navicular (tarsal)	Styloid proc.ulna Lunate (4-5) Upp.epiph.fibula 2nd cuneiform Navicular (tarsal) Heads phalang.(feet) (4-9)
5	Med.epicond.humerus Upp.epiph.radius Lunate & gr.multang.	Med. epicond.humerus Upp.epiph.radius Lunate & gr.multang.	Med.epicond.humerus Union head & tuberolas humerus Upp.epiph.radius Lunate & gr.multang.	Med. epicond.humerus U.head & tub.humerus Upp.epiph.radius Low.epiph.ulna(5-7) Gr.multangular Navic.(carpal)(5-6) Gr.troch.famur
6	Union head & tuberoles humerus Naviculer (carpal)	Union head & tuberolas humerus Navicular (carpal)	Navicular (carpal)	Less.multang.(6-8) Union isch.& pub. (6-8)
7	Union isch.& pub.(7-8)	Less.multang. (7th?) Union isch.& pub.(7-9)	Less.multang. (7th?) Union isch.& pub.(7-8)	
8	Less.multengular	Olecranon,ulna (8-9) Pisiform (8-11)		Epiph.os calcis(9th)
10	Olecrenon,ulna Epiph.os calcis	Trochlee,humerus(10-11) Epiph.os calcis	Olecrenon,ulna Epiph.os calcis	Trochlee,humerus Olecranon,ulna
11	Less.troch.femur(11-13)	Less.troch.femur(11-13)		
12	Trochlee,humerus Pisiform	Lat.epicond.humerus (12-14)	Trochlae,humerus Pisiform	Lat.epicond.humerus (12-13) Pisiform Less.troch.femur(12-14)

Chart VII

No. 2 APPEARANCE AND UNION OF BONE CENTERS BY YEARS, ACCORDING TO

Yrs.	GRAY'S ANATOMY	BAETJER AND WATERS	KNOX	ROTCH
13	Lat.epicond.humerus (13-14)		Lat.epicond.humerus (13-14) Lesc.troch.femur(13-14)	
15	A.of acremion (15-16) Sec.centers os coxae U.of epiph.os calcis	A.of acromion Inf.angle scapula U.centers scapula (15-18) Sternal end clav. (15-17) A.of sec.centers os coxae a.Crest ilium (15-18) b.Acetabulum (15-16) U.of prim.centers os coxae	A.of acromion (15-17) Inf.angle scapula Sec.centers os coxae U.of epiph.os calcis	Union of:- Epiph.os calcis Prim.centers os coxae
16	A.of inf.angle scapula U.of olecranon	Union of:- Upp.epiph.radius (16-17) Heads phalang.hand(16-17)	Union of:- Dist.extr.humer.(16-18) Olecranon	
17	Union of:- Upp.epiph.radius(17-18) Lesc.troch.femur	Union of:- Olecranon Low.epiph.radius (17-18) Heads metacarpals (17-18) Head femur (17-18) Lesc.troch.femur Low.epiph.tibia (17-18) Low.epiph.fibula (17-18) Heads metatars.(about 17) Heads phalanges foot (about 17)	Union of:- Lesc.troch.femur Upp.epiph.radius(17-18)	
18	A.of sternal end clavicle (18-20) Union of:- Dist.extr.humerus Heads phalang.hand (18-20) Prim.centers os coxae Head femur Gr.troch.femur Low.epiph.tibia Heads metatars.(18-20) Heads phalang.foot	Union of:- Dist.extr.humerus (18-19) Low.epiph.ulna Gr.troch.femur Low.epiph.femur (18-20) Upp.epiph.tibia (18-20) Upp.epiph.fibula (18-25)	A.of sternal end clavicle (18-20) Union of:- Heads metacarpals Heads phalang.hand (18-20) Prim.centers os coxae Head femur Gr.troch.femur Low.epiph.tibia Heads metatars.(18-20)	A.of sternal end clavicle Union of:- Gr.troch.femur Lesc.troch.femur
20	Union of:- Upp.epiph.humerus Low.epiph.ulna Low.epiph.radius Heads metacarpals Sec.centers os coxae (20-25) Low.epiph.femur Upp.epiph.tibia Low.epiph.fibula	U.of sec.centers os coxae	Union of:- Upp.epiph.humerus Low.epiph.ulna Low.epiph.radius Sec.centers os coxae (20-25) Low.epiph.femur Upp.epiph.tibia Low.epiph.fibula	
25	Union of:- Centers scapula Sternal end clavicle Upp.epiph.fibula	U.of sternal end clavicle (23-25)	Union of:- Centers scapula (22-25) Sternal end clavicle Upp.epiph.fibula	

Chart VIII

APPEARANCE AND UNION OF BONE CENTERS

ENGELBACH AND MCMAHON

Yrs.	
1	Coracoid process scapula Head of humerus (6-7 mos.) Capitate and hamate Head of femur Upper apiphysis tibia (birth) Third cuneiform
2	Greater tubercle humerus Capitellum, humerus Lower epiphysis radius Patella (2-3 yrs.) Lower apiphysis tibia Lower epiphysis fibula First and second cuneiforms (2-4 yrs.)
3	Os triangularis Heads of metacarpals Heads of phalanges Heads of metatarsals (3-7 yrs.)
4	Lunate Greater trochanter femur Upper epiphysis fibula (3-4 yrs.) Navicular (tarsal)
5-6	U. of head and tubercles humerus Medial epicondyle humerus Upper epiphysis radius Greater multangular Lesser multangular (6-8 yrs.) Navicular (carpal) (5-6 yrs.)
7	Lower epiphysis ulna U. of ischium and pubis Epiphysis os calcis (7-9)
9	Pisiform (9-11)
10	Olecranon, ulna Trochlea, humerus
11	Lateral epicondyle humerus (11-12 yrs.)
13	Lesser trochanter femur
14	U. of heads of metacarpals (14-15 yrs.
15	A. of acromion Inferior angle scapula U. of centers of scapula (15-18 yrs.) A. of sternal end clavicle (15-17 yrs.) U. of heads of phalanges, hand A. of secondary centers os coxae a. Crest of ilium (15-18 yrs.) b. Acetabulum (15-16 yrs.) U. of primary centers os coxae
16	Union of:- Distal extremity humerus Olecranon, ulna Upper epiphysis radius Heads of metatarsals Heads of phalanges, foot
17	Union of:- Lower epiphysis radius Lesser trochanter femur
18	Union of:- Head of humerus Head of femur Greater trochanter femur Lower apiphysis tibia
18-20	Union of:- Lower apiphysis ulna Secondary centers os coxae (20-25 yrs.) Lower apiphysis femur Upper apiphysis tibia Lower epiphysis fibula Upper apiphysis fibula
22-25	U. of sternal end clavicle

Aged 3. An example of a normal variation in the devolpment of the carpal bones at this age is shown in Fig. 5. The picture to the left shows three carpal bones, the capitate, hamate, and os triangularis, with a well developed head of the radius. The one to the right shows four carpal bones, hypothyroid shoulder on the right shows the head of the greater tubercle just appearing, consequently undeveloped, representing a development of about 19 months.

Aged 4. Fig. 7 compares the normal with a hypothyroid hand of the same age. The normal hand shows four carpals pres-

Chart IX
X-RAY PLATES FOR BONE DEVELOPMENT
ENGELBACH AND MCMAHON

Yrs.		Yrs.	
1-5	(1) Full figure, divided on two plates. (2) Hands and feet, taken separately. (3) Lateral knee for patella.	14	Plates listed under ages 13 and 15.
6	(1) Carpals and tarsals. (2) Shoulder. (3) Pelvis.	15	(1) Clavicle. (2) Scapula. (3) Pelvis (half). (4) Lateral foot. (5) Hand. (6) Lateral elbow.
7	(1) Pelvis. (2) Carpals.	16	Elbow (lateral). (anteroposterior).
8	(1) Carpals. (2) Lateral foot.	17	Pelvis.
9	(1) Carpals. (2) Lateral foot.	18	(1) Carpals. (2) Tarsals. (3) Shoulder. (4) Pelvis, with hip joint. (5) Ankle (anteroposterior).
10	(1) Elbow (lateral). (anteroposterior). (2) Lateral foot.	19	Plates listed under ages 18 and 20.
11	Plates listed under ages 10 and 12.	20	(1) Carpals, with wrist. (2) Knee (anteroposterior). (3) Ankle (anteroposterior).
12	(1) Elbow (lateral). (anteroposterior). (2) Carpals.	To 25	(1) Clavicle. (2) Scapula. (3) Pelvis. (4) Knee.
13	(1) Hip, with half pelvis. (2) Anteroposterior elbow.		

with appearance of the lunate and faint appearance of the head of the radius. The head of the first metacarpal is present on the left, and absent on the right. These variations occur in subjects who are of normal type. A slightly advanced development of the carpals, with apparently delayed development of the head of the radius, is not an infrequent association.

A comparison of the shoulders of a normal and a hypothyroid subject of three years is shown in Fig. 6. The normal shoulder on the left shows the greater tubercle well developed. This tubercle normally appears in the second year. It is completely separated from the head of the humerus, establishing its separate origin. There has been some contention about this point. The ent, the capitate, hamate, os triangularis, and os lunatum. The heads of all metacarpals and phalanges are well developed. The hypothyroid hand at four shows two carpals, the capitate and hamate, while the triangular and lunate are absent. The heads of the metacarpals and phalanges, with the exception of the heads of some phalanges, are present but undeveloped for the age. The carpal development is to the age of two. The delayed development of the carpals is an outstanding feature in hypothyroid cases, although rather constant delayed development in the epiphyses of all long bones has been found.

A comparison of a normal with a hypothyroid shoulder at the age of four is made in Fig. 8. The greater tubercle of the hu-

merus is normal in the picture on the left, with beginning fusion with the head. In the hypothyroid subject, the greater tubercle is undeveloped, with complete separation from the head, thus emphasizing the

The radiograms of the knee joint at the age of four in Fig. 10 show in the normal subject on the left the presence of a fairly well developed upper epiphysis of the fibula, which normally appears between the

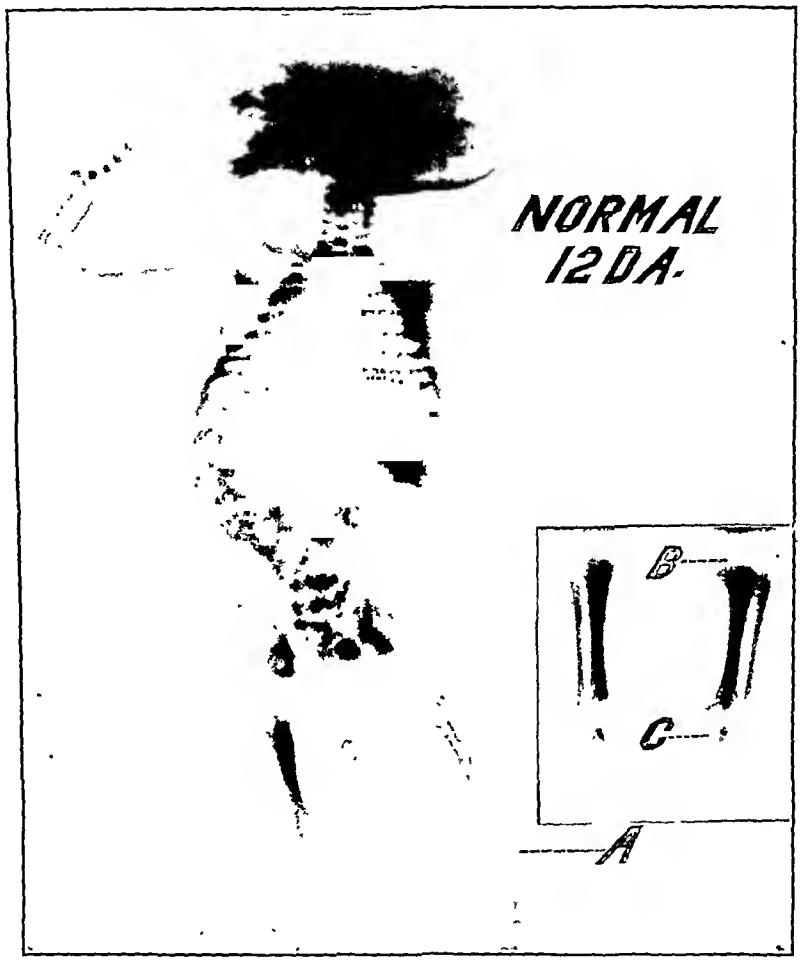


Fig. 1.

importance of centers other than the carpals.

A radiogram of the pelvis at the age of four (Fig. 9) demonstrates the center for the greatest trochanter of the femur (A) present in the normal subject (No. 1). This center (A) is absent in No. 2. There is also a difference in the development of the head of the femur. It is to be noted that the separation of the pubis and ischium is more pronounced in the hypothyroid pelvis (No. 2). These do not normally fuse until about the seventh year.

third and fourth years. This center is absent in the hypothyroid knee on the right, and there is general underdevelopment of the other centers present, i.e., the lower epiphysis of the femur and the upper epiphysis of the tibia. This further emphasizes the point made above, that the underdevelopment of the osseous system in hypothyroidism is not limited to the carpal bones.

Fig. 11 illustrates the development of the feet at the age of four. The normal foot on the left shows the appearance of the center for the navicular, with the other tarsals well

Fig. 2. Effect of treatment upon hypothyroid. (1) 26 months old, before treatment. Note absence of hamate, os triangularis, and head of radius. (2) Same case after treatment, at 41 months. Note head of radius, capitate, hamate, os triangularis, and lunate. (3) Same case at 56 months. Note enlargement of head of radius and carpal bones present in Fig. 2, and presence of head of first metacarpal.

developed, the cuboid and the first, second and third cuneiform. These last three appear within the first two years. The illustration on the right, a hypothyroid foot, shows the navicular and second cuneiform missing. The center for the first cuneiform, appearing within the second year, is faintly seen. It is to be noted that the center for the head of the first metatarsal is also undeveloped, as contrasted with the normal foot. The hypothyroid foot represents about a two-year development.

Fig. 12 is a radiogram of the carpal bones of a subject aged 4 with a clinical diagnosis of hypothyroidism. It is interesting to note that there is an overdevelopment of the carpal bones, the six present being the capitate, hamate, os triangularis, lunate, navicular, and lesser multangular. There is also an accessory head of the second metacarpal. The hand represents about a six-year development. It is in these cases that the study of the osseous development assumes importance for diagnostic purposes. We assume a pluriglandular involvement, which may account for the advanced carpal development, not typical of the true cretin.

In Fig. 13 the hand of a normal four-year child is contrasted with that of a subject with suspected hyperpinealism. The normal hand is smaller than the comparison hand, while the carpal bones are present for the age. The suspect hyperpineal hand is developed to the age of twelve, with all the carpals present, including the pisiform. The heads of the metacarpals and phalanges are likewise well developed, together with the heads of the radius and ulna.

Fig. 3.

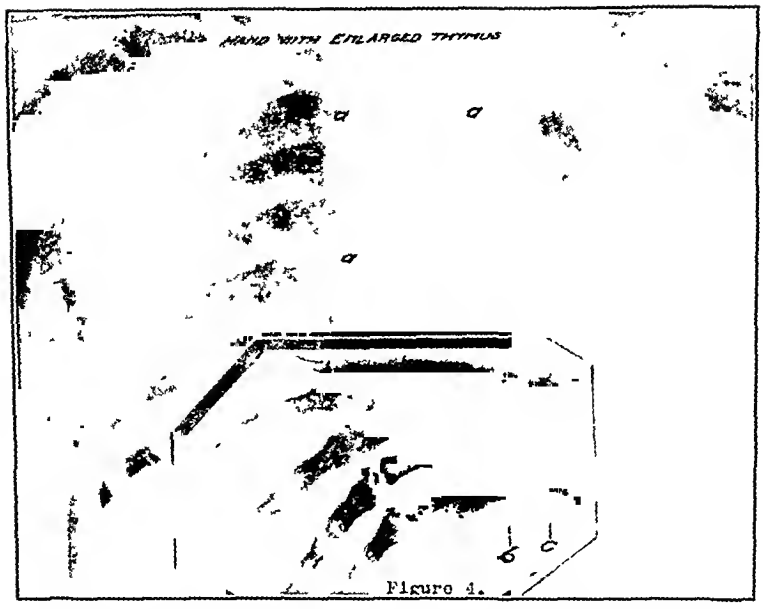


Fig. 4. Aged 2 years, 10 months Thorax: (a, a, a) Enlarged thymus Insert of hand: (b) Absence of os triangularis. (c) Absence of head of radius. Note absence of heads of metacarpals.

Aged 5. In Fig. 14 the hypothyroid hand (Plate No. 1) is developed to the age of two, with three carpal bones absent, the os triangularis, os lunatum, and navicular; while Plate No. 2 shows a normal variation in the carpal development for the age of

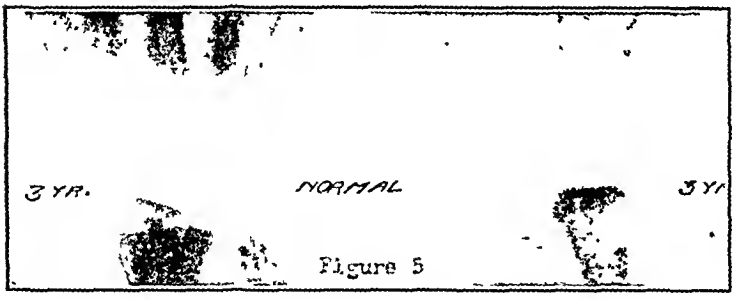


Fig. 5. Carpal bones for normal, aged 3. Showing normal variation in appearance of carpals. Note well developed head of radius on left, and appearance of head on right. Also presence of head of first metacarpal on left, absence on right.

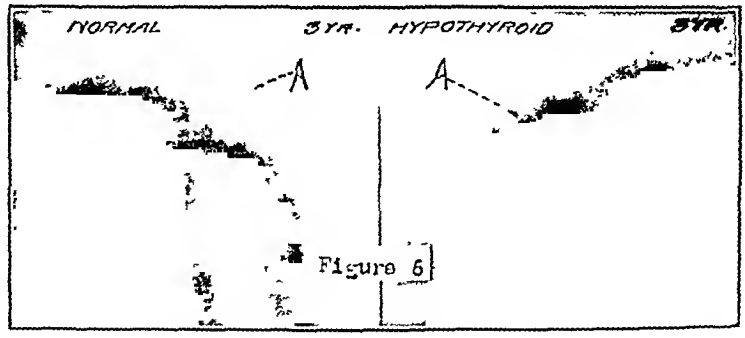


Fig. 6. (1) Normal, aged 3. (A) Greater tubercle of humerus well developed. (2) Hypothyroid, aged 3. (A) Greater tubercle of humerus undeveloped

five, with no obvious endocrine dysfunction to account for the slightly advanced development. The heads of the metacarpals of the hypothyroid hand are developed to the age of three. It is to be noted in Plate

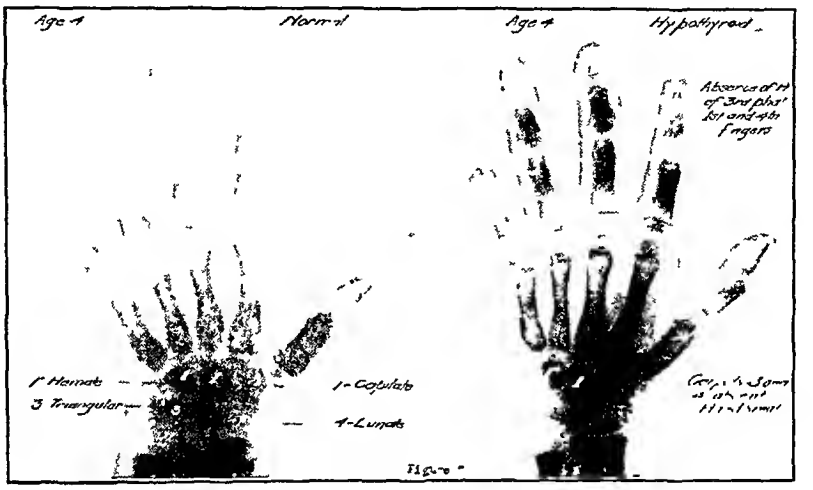


Fig 7

Fig 8. Aged 4 Normal shows (A) greater tubercle of humerus well developed; (B) partially fused with head of humerus Hypothyroid shows (A) greater tubercle of humerus undeveloped; (B) absence of fusion of head and greater tubercle

No. 2 that all the carpal centers are present except the pisiform. The os triangularis and os lunatum are not fully developed for the age. The head of the radius is well developed.

Plate No. 1 (Fig. 15) is the elbow of a normal five-year-old child. Plate No. 2 is an elbow of a hypothyroid child of the same age. In the normal subject on the left the centers for the medial epicondyle and head of the radius are present, the latter just appearing, while the capitellum is well developed. In the hypothyroid subject there is an absence of these centers, together with underdevelopment of the capitellum. The difference in size and density of the bones is to be noted.

Fig. 16 is a comparison of the foot of a hypothyroid child of five years with that of a normal child of the same age. In the hypothyroid foot on the right the navicular and the heads of the second to the fifth metatarsal, and many of the phalangeal heads are absent. The second cuneiform is undeveloped. This foot represents about a three-year development.

Aged 6. In Fig. 17 the same underdevelopment of the carpals is seen in the hypothyroid subject on the right as has been found at other ages. The navicular and the greater and lesser multangulars are absent, together with delay in development of the heads of the metacarpals and phalanges. The carpals present are developed to the age of four.

A case of suspected hyperpinealism at the age of six is contrasted with the normal condition for the same age in Fig. 18. The carpal bones, metacarpals, and phalanges are large, developed to about the age of fourteen, with beginning closure of all epiphyseal lines, particularly evident in the metacarpals. The head of the ulna, which is absent in the normal, is well developed in the subject with suspected pinealism. This overdevelopment of the osseous system for the age is characteristic of this type of case. Early closure of the epiphyseal lines is a constant feature. The same advanced development may be seen in the other epiphyses about the body. It is unusual in these cases to find the epiphyseal lines open after the fifteenth year. The epiphyseal lines of the long bones normally close at about the eighteenth year.

In Fig. 19 are two elbows. No. 1 on the left is that of a normal subject aged 6, while No. 2 on the right is that of a hypothyroid. In the normal elbow on the left the medial epicondyle is faintly visible, while the head of the radius is fairly well developed. These are absent in the hypothyroid elbow on the right. There is a general underdevelopment of the bones in the latter.

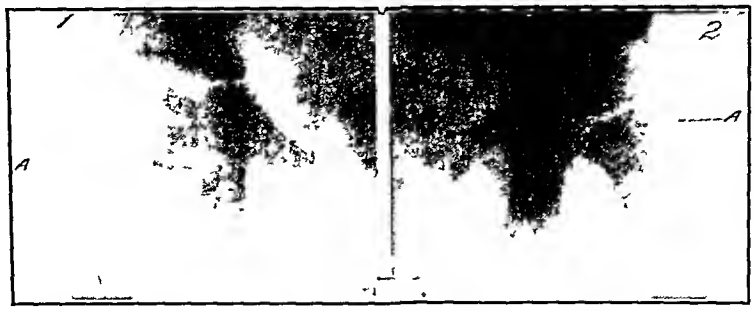


Fig. 9. (1) Normal, aged 4. (A) Presence of greater trochanter of femur. (2) Hypothyroid, aged 4. (A) Absence of greater trochanter of femur.

Fig. 10.

Aged 7. In Fig. 20 the hypothyroid subject on the right again demonstrates the underdevelopment of the carpals. The normal subject on the left shows all carpal centers present and well developed, with the head of the ulna likewise present. This is the earliest age at which the writers have found this center appearing, although most authorities state that it appears one or two years earlier. The hypothyroid subject on the right shows underdevelopment of the carpal bones, which the writers have found so constantly in these cases. There is an absence of the head of the ulna. The hand is developed to about three years.

The carpal development in the hypothyroid hand in Fig. 21 at age 7 might well be contrasted with that of the hypothyroid in Fig. 20. The difference between the two is evident. In that of Fig. 21 we have all

the centers present for the age, but not developed to normal size. The head of the ulna is absent. The heads of the metacarpals and phalanges show the same underdevelopment. Clinically this case is one of seven, it is absent, while in B, at the age of nine, the center is just appearing, being well developed in C, at the age of seven, probably appearing at about the sixth year in this patient. In this last case the other epi-

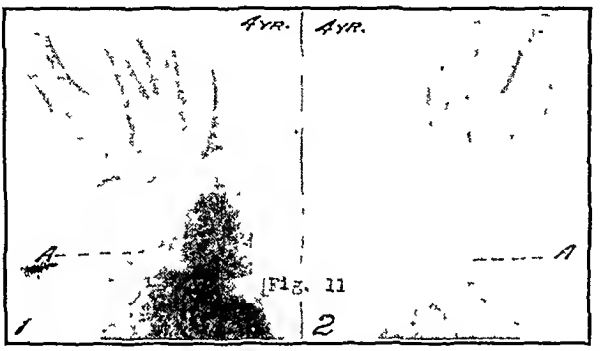


Fig. 11. (1) Normal, aged 4. (A) Presence of navicular. (2) Hypothyroid, aged 4. (A) Absence of navicular. Absence of second cuneiform, with underdevelopment of all tarsals.

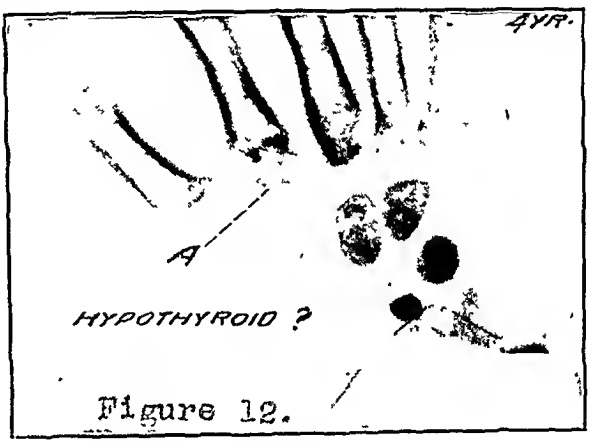


Fig. 12. Aged 4. Clinical diagnosis, hyperthyroid, doubtful because of advanced carpal development for age. Presence of navicular and lesser multangular. (A) Accessory head of second metacarpal.

hypothyroidism. The importance of radiographic examination in these cases of minor deficiency cannot be over-emphasized, for where clinical characteristics are absent, it is frequently possible to make a diagnosis from the radiographic examination.

A radiogram of the pelvis of a hypothyroid subject, aged 7, contrasted with the normal pelvis in Fig. 22, shows separation of the pubis and ischium in the hypothyroid on the right, while fusion of the two bones is complete in the normal on the left. This fusion has been found to occur normally at this age. The hypothyroid pelvis represents a development of about five years.

Aged 7 to 9. The radiogram in Fig. 23 shows the variations that occur in the appearance of the center for the epiphysis of the calcaneus. This normally appears between 7 and 9 years. In A, at the age of

physeal centers about the body were developed to a degree normal for the age.

Aged 9 and 10. The pisiform is present in No. 1 (Fig. 24), the hand of a patient aged 9 with thyro-pituitary insufficiency, while it is absent in the hypothyroid subject (No. 2) aged 10. This condition, together with a general tendency toward slight advancement in the carpal development, has been found frequently in these cases of thyro-pituitary insufficiency. The carpal bones in the thyro-pituitary insufficiency are denser than those of the hypothyroid patient, with more tendency to massing. The pisiform appears normally between 9 and 11 years.

The elbow of the thyro-pituitary subject (Fig. 25, No. 1) at 9 years gives evidence of the tendency to slightly advanced osseous development, as has been seen in Fig. 24.

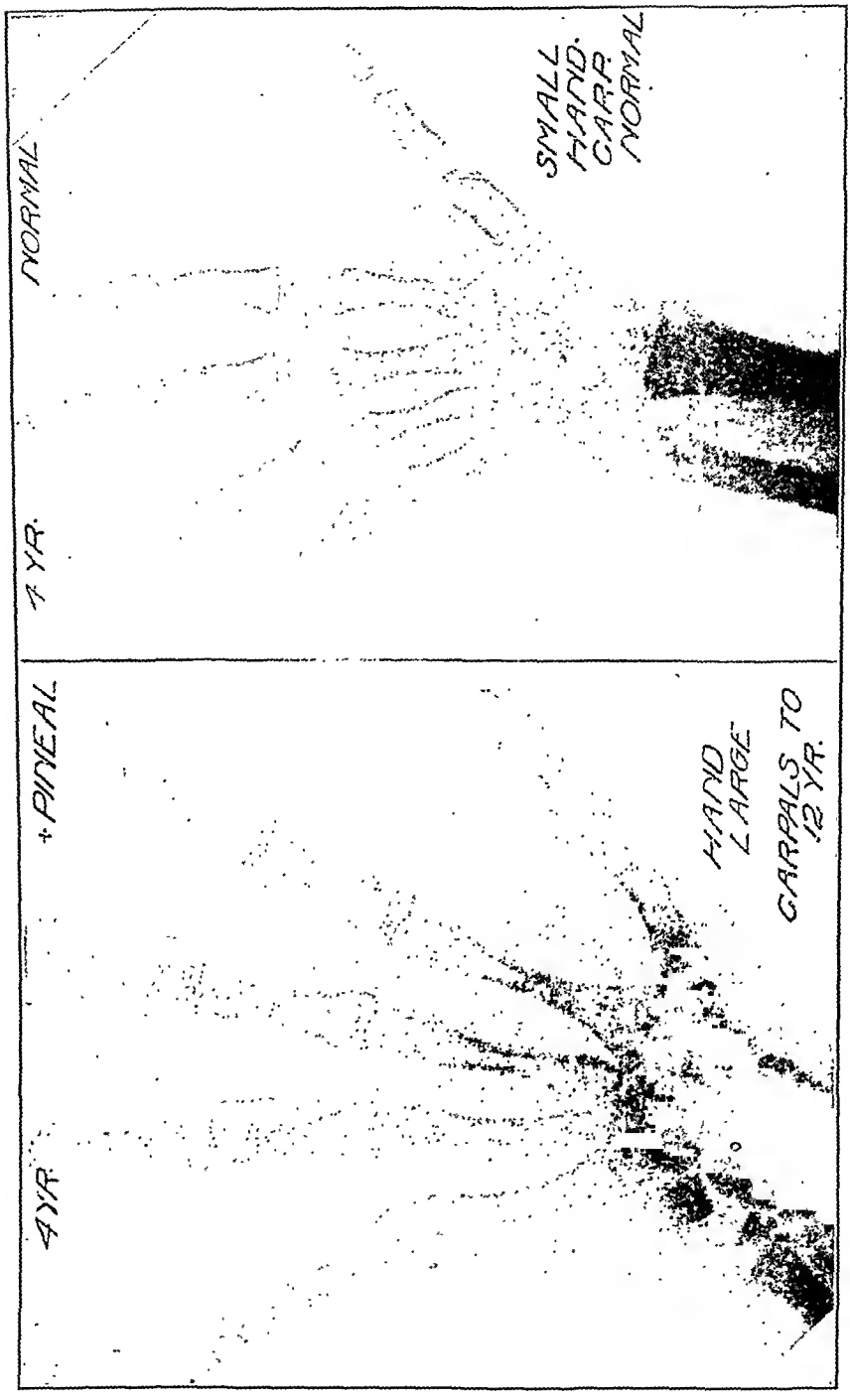


Fig. 13.

This is apparent in the appearance of the lateral epicondyle of the humerus and well developed olecranon and trochlea, while in the normal child (No. 2) of 10 years the center for the lateral epicondyle is just appearing. This has been found present normally from 10 to 12 years. The center for the olecranon is about the size for the age, the center for the trochlea being absent. This last appears about the tenth year.

Aged 10 and 11. In Fig. 26 the elbow of a subject, aged 11, with a pluriglandular (pituitary-thyroid) deficiency is compared with the elbow of a normal child, aged ten. We have mentioned above in Figs. 24 and 25 that the thyro-pituitary sub-

ject shows a tendency to a slight advance in the osseous development, as contrasted with the pure thyroid. This advanced development has been seen chiefly in the carpals and centers for the long bones. The subject with pituitary-thyroid deficiency[3], on the other hand, shows a tendency to a slight delay in the development of these centers. These points have been brought out in a limited series of cases, and suggest further study, with the confirmation of additional cases. The delayed development is seen in Fig. 26, in which the trochlea is absent in the pituitary-thyroid, and well developed in the normal subject. The olecranon is undeveloped in the pluriglandular, while absent in the normal subject, appearing at about the tenth year.

Fig. 27 shows a lateral view of the elbows of the same subjects as seen in Fig. 26, in which the trochlea and olecranon are well developed in the normal elbow on the left, while the trochlea is absent in the pituitary-thyroid elbow on the right, and the center for the olecranon has just appeared.

Aged 11. In the normal elbow (No. 1, Fig. 28) the lateral epicondyle of the humerus has just appeared, while the same center is absent in the pituitary-thyroid elbow on the right. The olecranon is well developed in the normal and small in the pluriglandular elbow. The trochlea is also well developed in the normal and absent in the pluriglandular elbow.

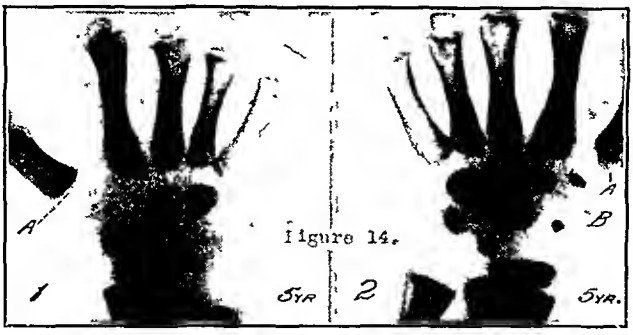


Fig. 14. (1) Hypothyroid. aged 5. Carpals for age absent—os triangularis, lunate, navicular. and greater multangular. Head of first metacarpal absent. (2) Advanced carpal development for age, lesser multangular present. Head of first metacarpal present.

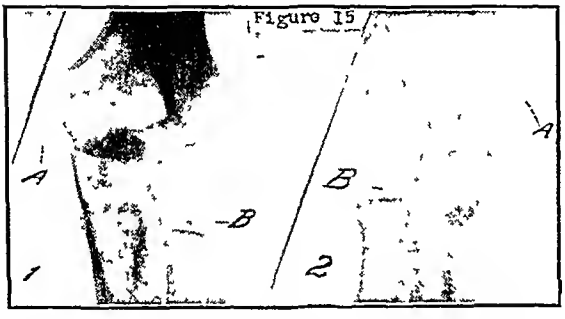


Fig. 15. (1) Normal, aged 5. (2) Hypothyroid, aged 5. Note absence of internal condyle of humerus and head of radius in Fig. 2.

Aged 13. In the above Fig. 29 the pluriglandular (pituitary-thyroid) hand shows beginning closure of the epiphyseal lines of the metacarpals and phalanges. The heads of the metacarpals normally fuse between 14 and 15 years, while the heads of the phalanges fuse at 15 years. The hypogonad hand on the right has all epiphyseal lines clearly open, being much larger than the pituitary-thyroid hand, with more pronounced development of the metacarpals and phalanges. The striking difference, however, lies in the open epiphyseal lines of the hypogonad hand, a fact which is brought out constantly in this type of case in later years.

Aged 13 and 14. The same pituitary-thyroid hand as seen in Fig. 29 is compared in Fig. 30 with a hypothyroid hand at 14 years. The pituitary-thyroid hand on the left is much larger than the hypothyroid hand on the right, showing beginning closure of the epiphyseal lines of the metacarpals and phalanges. The carpals are well developed for the age. The appear-

[3]The distinction between thyro-pituitarism and pituitary-thyroidism lies in the fact that in the former there is early hypothyroidism, with a subsequent pituitary deficiency, while in the latter the pituitary deficiency antedates and is complicated by the thyroid deficiency

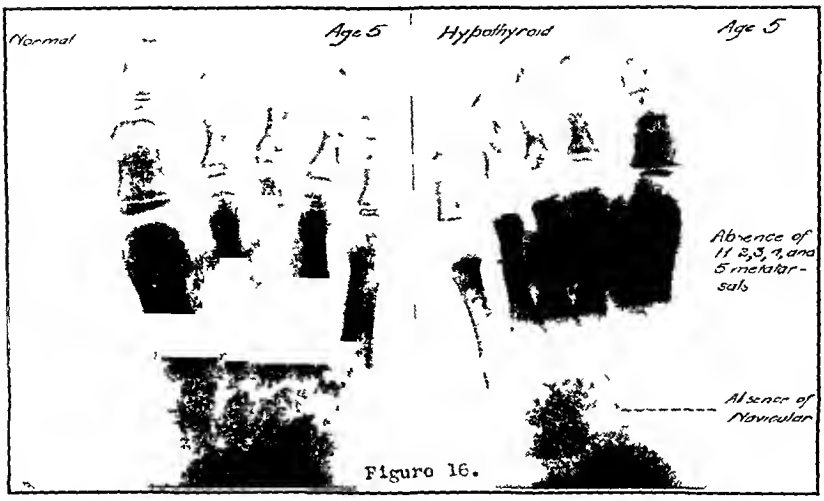


Fig 16

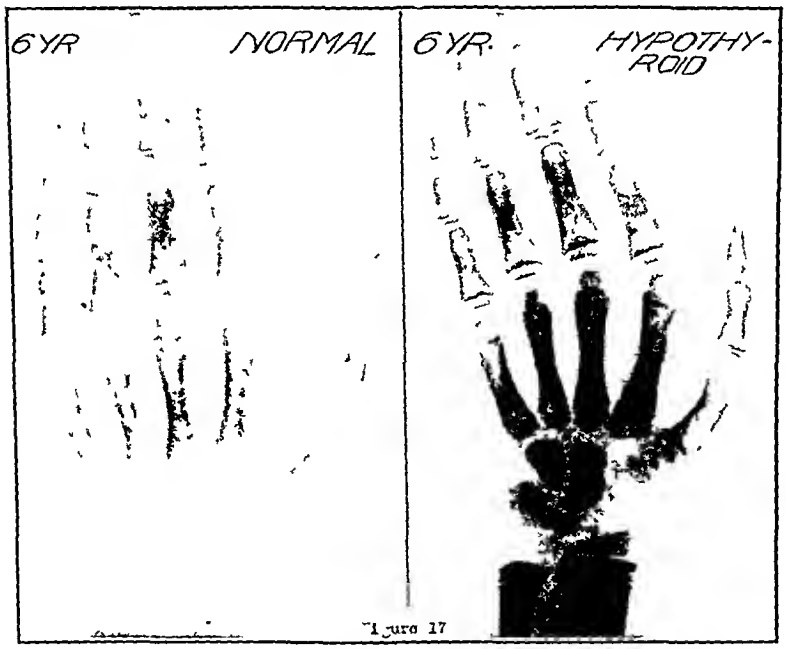


Fig 17.

ance of the carpal centers after 9 to 11 years, at which time the pisiform appears, is not of particular value in the diagnosis of endocrine dysfunction. However, the underdevelopment of the carpal centers, as is seen in the hypothyroid hand at 14 years, together with a delayed closure of the epiphyseal lines, can be used as a diagnostic sign.

Aged 14. The radiogram shown in Fig. 31 is that of a shoulder, with the center for the acromion plainly evident. This is said to arise from two centers. The writers have not been able to confirm this. The normal appearance for this center is from the fourteenth to the fifteenth year.

Aged 15 and 16. On the right, the hand of the subject with suspected hyperpinealism at the age of 15 in Fig. 32, presents a development of all bones of the hand far in advance of the normal hand, while the hypothyroid hand of a patient aged 16 on the left confirms the earlier signs of general osseous underdevelopment in this

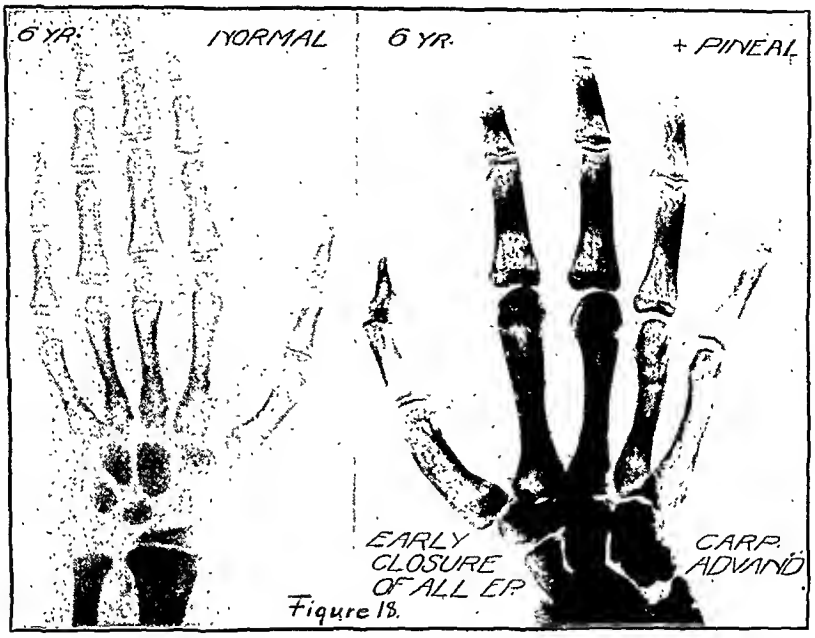


Fig. 18.

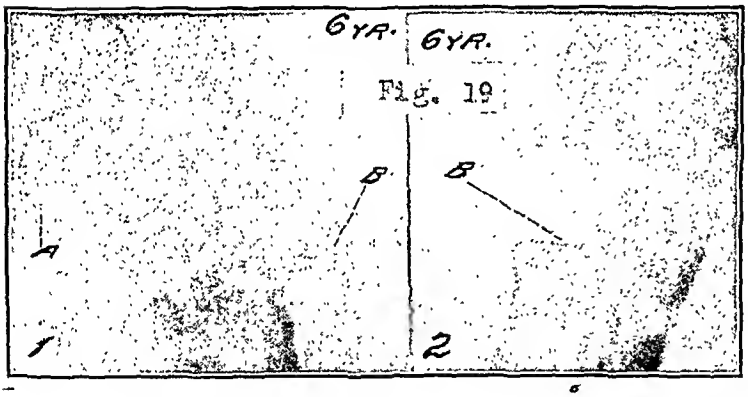


Fig. 19. (1) Normal, aged 6. (A) Appearance of medial epicondyle. (B) Presence of head of radius. (2) Hypothyroid, aged 6. (B) Absence of head of radius. Absence of medial epicondyle. Note difference in size of bones.

type of case. The hands resemble each other very closely in size, but differ in the density of the bones and most particularly in the fact that the former at 15 years has all epiphyseal lines closed, while the latter at 16 has epiphyseal lines open. There is complete union of the heads of the radius and ulna in the former. The head of the radius does not normally close until the seventeenth year, and that of the ulna, between the eighteenth and twentieth years. This early closure extends to all the long bones. The massing of the carpals is more pronounced in the subject with suspected hyperpinealism than in the hypothyroid subject.

In Fig. 33 the same suspected hyperpineal hand at the age of 15 is contrasted with the hand of a subject with anterior lobe pituitary deficiency at the age of 21. The characteristics of the former have been described under Fig. 32. The hand of the patient with anterior pituitary deficiency is small, but slightly larger than the pineal hand. There is, however, a persistence of all epiphyseal lines in the former, including the epiphyses of the radius and ulna, which normally close between 17 and 19 years. We have a contrast of early closure of epiphyseal lines and delayed closure in two subjects who from the standpoint of stature resemble each other closely but who

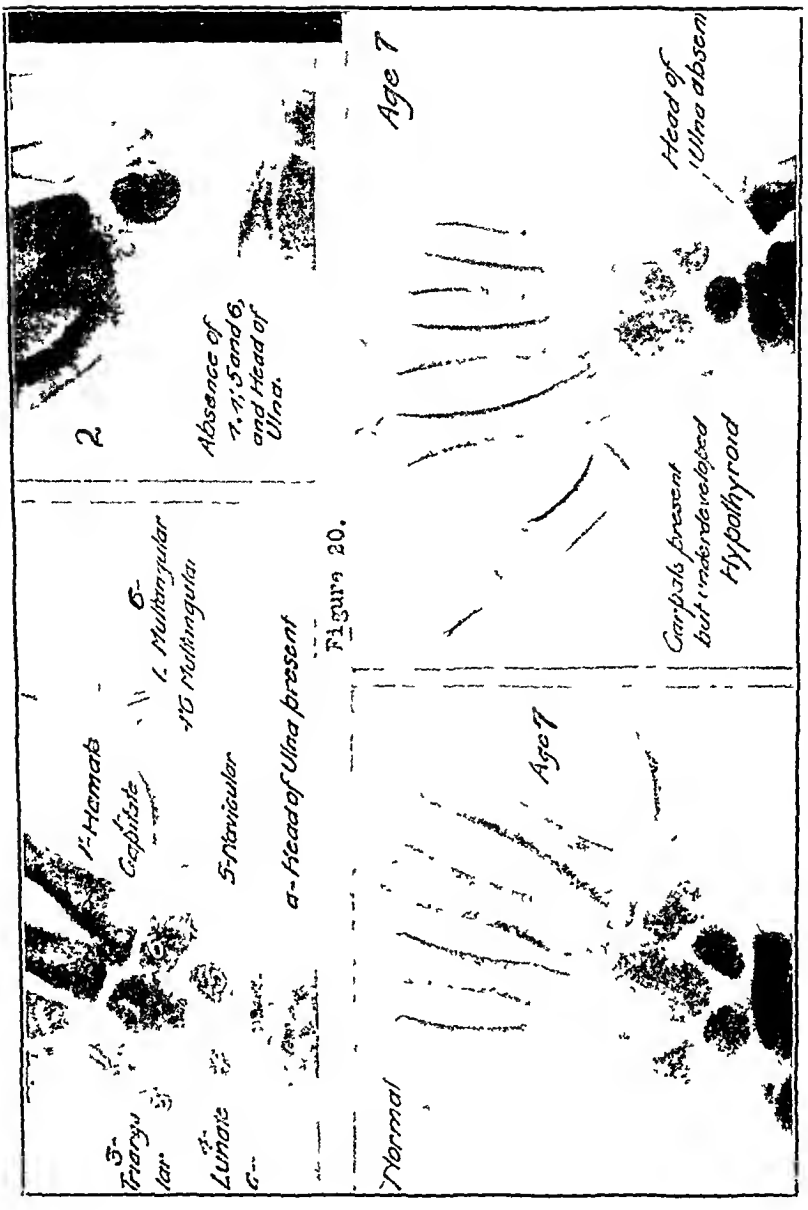


Fig. 20. (1) Normal, aged 7. All carpals present and well developed. Head of ulna present. (2) Hypothyroid, aged 7. Three carpals present; carpals absent Nos. 4, 4', 5 and 6. Head of ulna absent.
Fig. 21. Comparison of hypothyroid, aged 7, with normal, aged 7, on left.

differ widely in many important characteristics, such as mentality, the development of the primary and secondary sexual characteristics, etc. The etiological factor of the decreased stature in one is essentially different from that in the other. The early closure of epiphyseal lines in the suspected hyperpineal hand prevents normal growth, while the absence of the hormone of the anterior lobe of the pituitary results in a retardation of the normal growth of the long bones in this type of case, so that the stature remains small in spite of the fact that all epiphyseal lines remain open.

In Fig. 34 the shoulder of a normal subject aged 15 is contrasted with the eunuchoid shoulder of the same age. The center for the acromion is present in the shoulder on the left, and there is beginning closure of the epiphyseal line of the head of the humerus. Normally the head of the humerus is completely fused with the shaft at the eighteenth year. The eunuchoid subject on the right shows an absence of the

epiphysis of the acromion, with the epiphyseal line of the head of the humerus completely open. This delay in the closure of the epiphyses is, as mentioned above, characteristic of the hypogonad or eunuchoid type.

Aged 16. The center for the crest of the ilium is shown well developed in Fig. 35. This normally appears at the fifteenth year, together with the other secondary centers of the os coxæ. Other osseous findings at the age of 15 to 16 are the appearance of

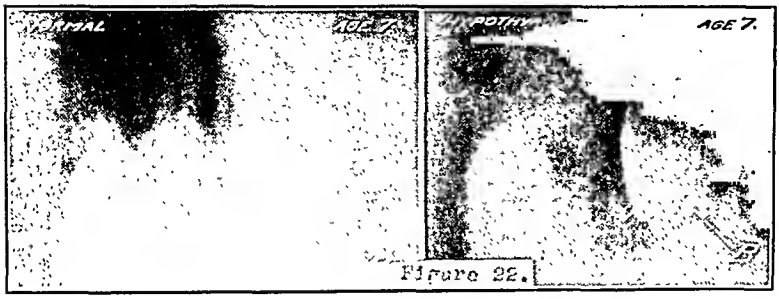


Fig. 22. Normal shows (A) Union of pubis and ischium. Hypothyroid shows (B) non-union of pubis and ischium.

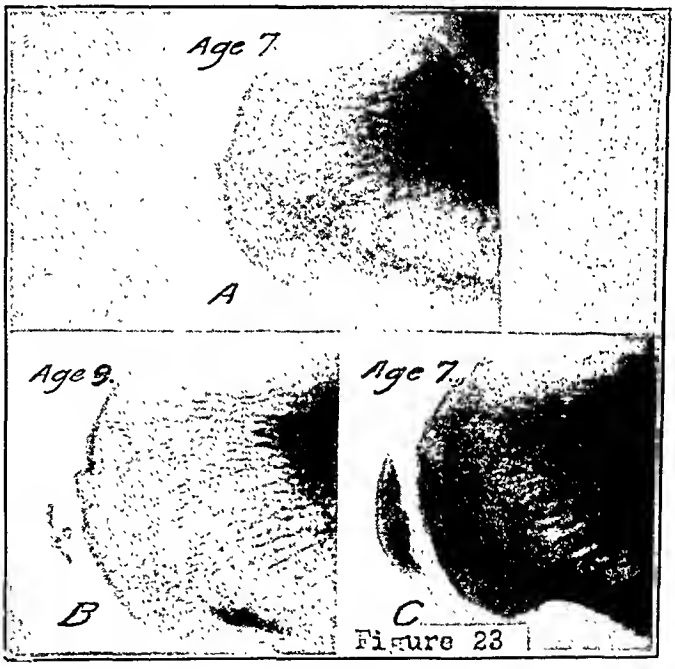


Fig. 23. (A) Normal, aged 7. Absence of epiphyseal head of calcaneus (os calcis). (B) Aged 9. Appearance of epiphyseal head of os calcis (occurs normally at 7 to 8). (C) Aged 7. Presence of head of os calcis.

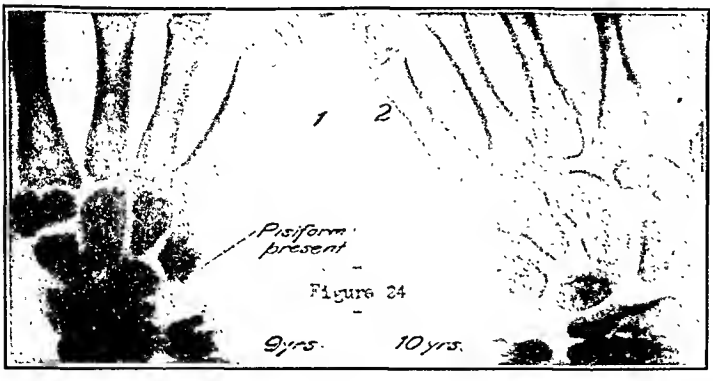


Fig. 24. (1) Thyro-pituitary insufficiency (aged 9). Note presence of pisiform. (2) Hypothyroidism (aged 10). Note absence of pisiform.

the sternal end of the clavicle, union of the heads of the phalanges of the hand, and union of the primary centers of the os coxæ.

In Fig. 36 is seen other evidence of the delay in the closure of the epiphyseal lines in the subject with anterior lobe pituitary deficiency. The normal elbow on the left of a subject aged 16 shows complete closure of the olecranon and practically complete closure of the epiphyseal line of the head of the radius. The elbow of the patient

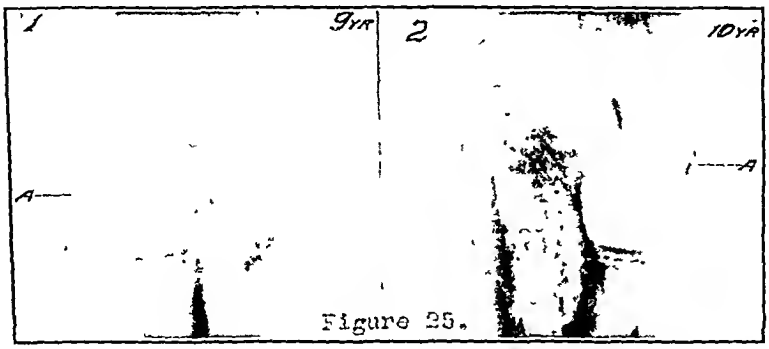
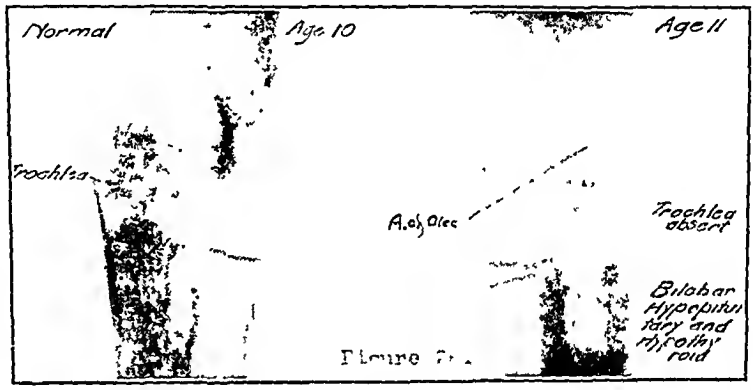


Fig. 25. (1) Thyro-pituitary, 9 years. (A) Well developed lateral epicondyle. Note well developed olecranon. (2) Normal, 10 years. (A) Appearance of lateral epicondyle. Olecranon small.

Fig. 26.



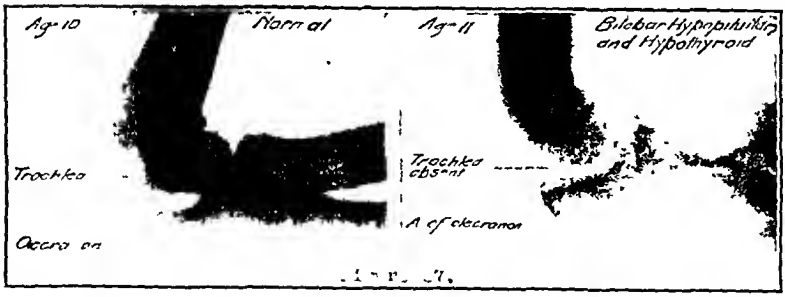


Fig. 27.

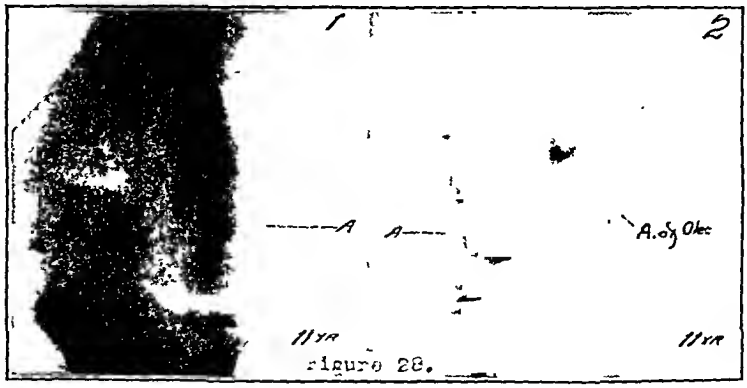


Fig. 28. Aged 11. (1) Normal. (A) Appearance of lateral epicondyle of humerus. (2) Pluriglandular, bilobar hypopituitarism, with hypothyroidism. (A) Absence of lateral epicondyle of humerus.

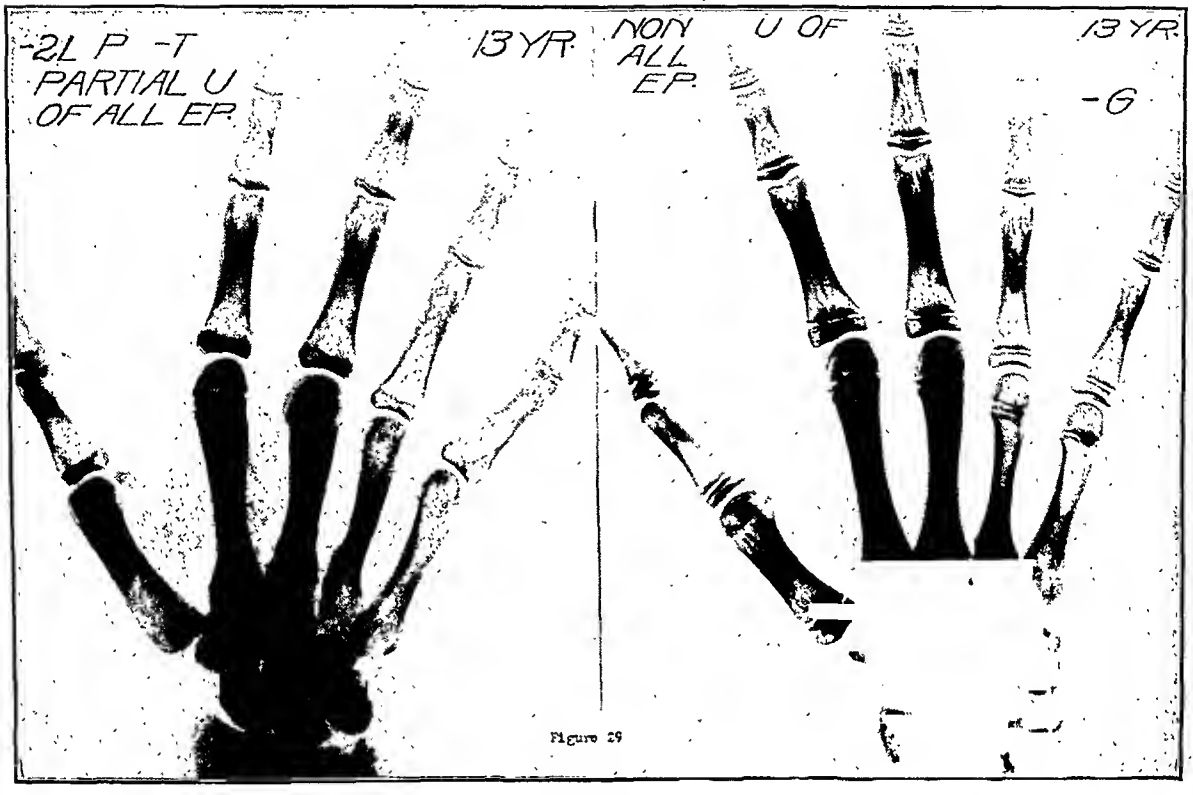

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Fig. 29.

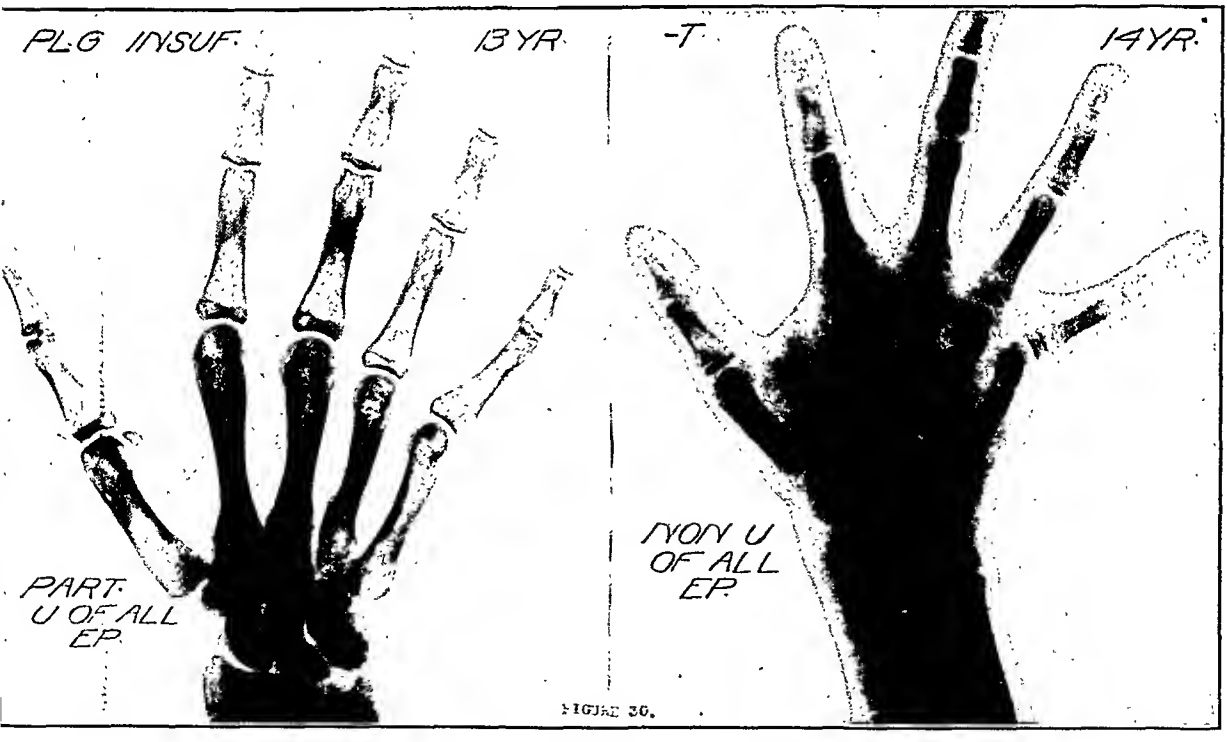
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Fig. 30.

with anterior lobe deficiency shows the epiphyseal lines open. The same delay in closure is seen in the distal epiphysis of the

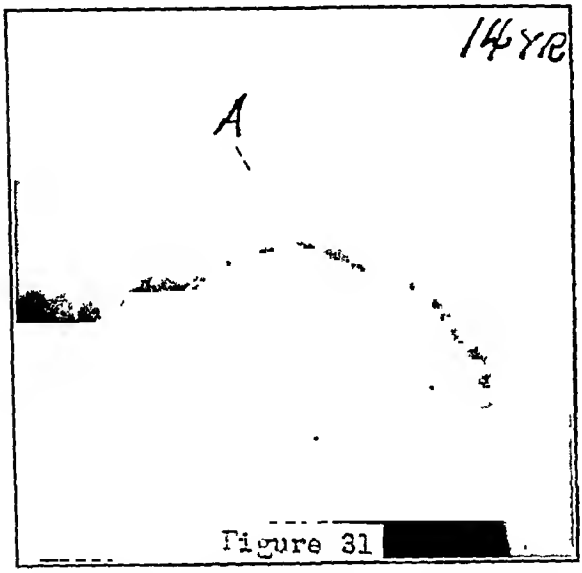

Fig. 31. Normal, aged 14 (A) Appearance of acromion.

humerus, this normally closing at about 16 years.

Aged 18. The subject with pluriglandular deficiency (pituitary-thyroid) in Fig. 37 shows a delay in the closure of all epiphyseal lines, the epiphyseal lines of the metacarpals and phalanges normally closing at 15 to 16 years, while the epiphyseal lines of the radius and ulna, which are still present in this hand, normally close between the seventeenth and nineteenth years. The hypothyroid hand on the left shows closure of all epiphyseal lines, which is normal for the age. The hands resemble each other very closely in size.

Aged 20. The hypogonad hand on the right in Fig. 38 shows a general increase in length, with a persistence of the epiphyseal lines of the metacarpals, phalanges, radius, and ulna. The hand is slender, the increase in length being accounted for by the failure of the epiphyseal lines to close, as they do normally between the fifteenth and nineteenth years. The normal hand on the left shows all epiphyses closed.

The radiograms of the elbows of the same subjects as seen in Fig. 38 are contrasted in Fig. 39. All epiphyses are closed in the normal elbow. There is complete fusion of the separate centers of the distal extremity of the humerus, together with fusion of the distal extremity of the humerus with the shaft. The olecranon and

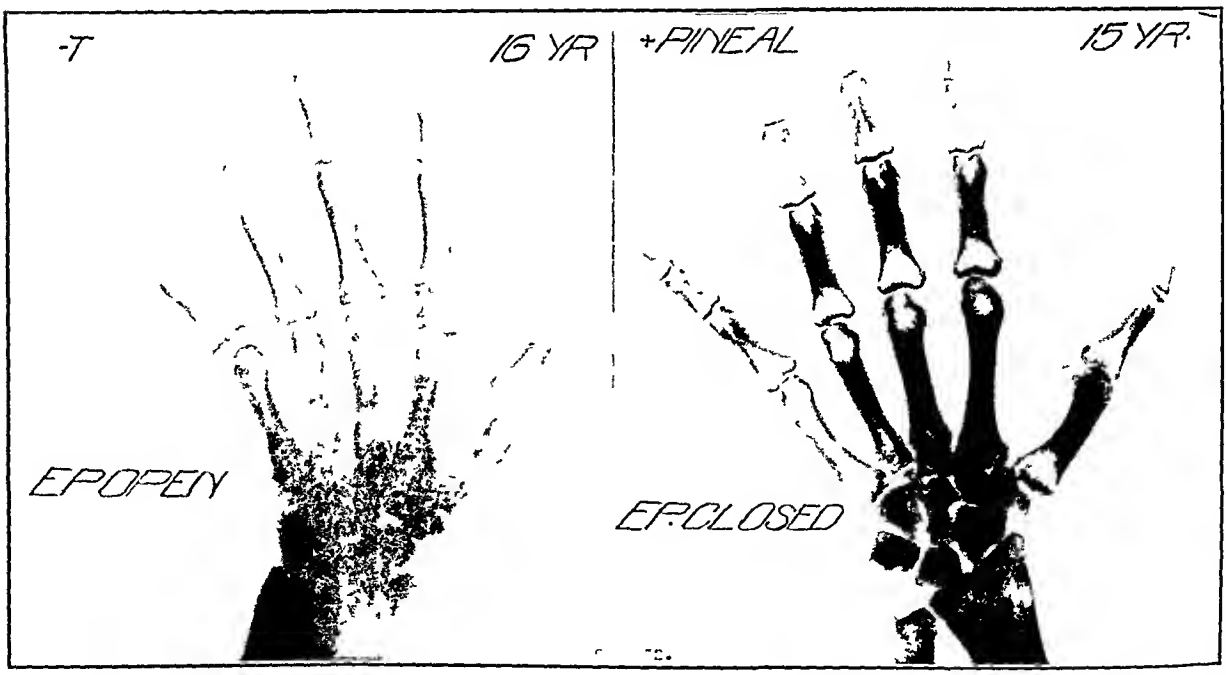

Fig 32.

the head of the radius are closed, these normally closing from the sixteenth to the nineteenth years. These epiphyses are frankly open in the hypogonad elbow on the right.

bones, with resultant increase in stature due to a preponderance of long bone development.

In Fig. 41 the epiphyses of the elbow of

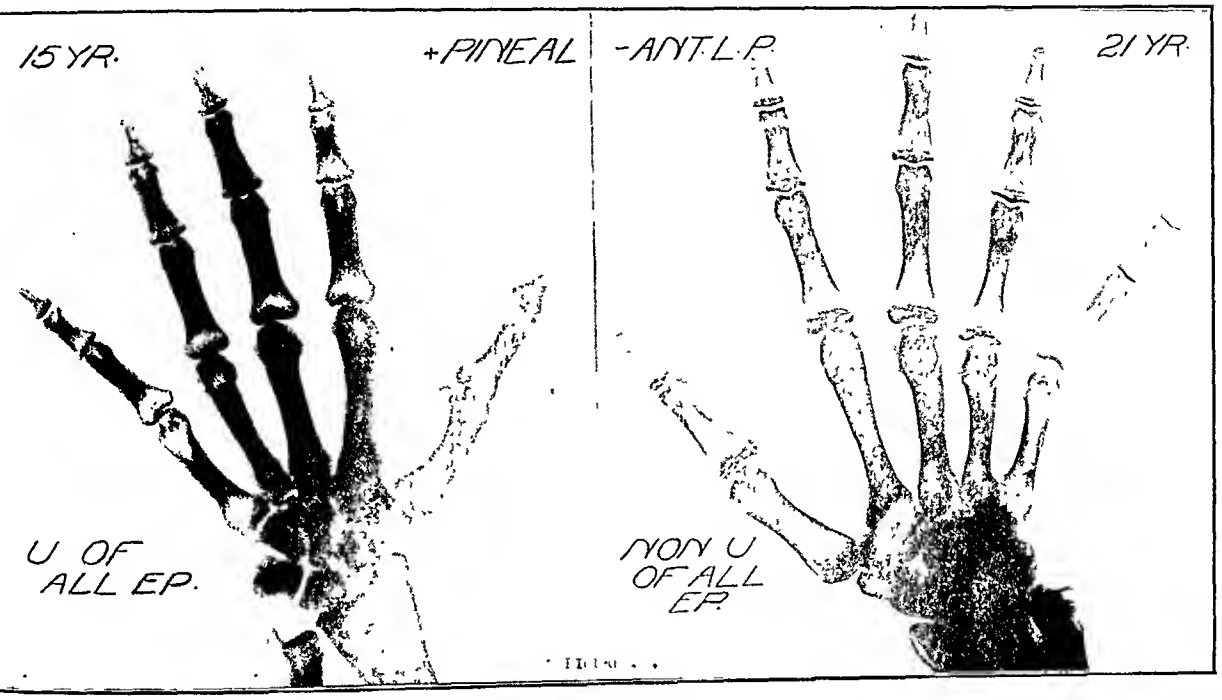

Fig. 33.

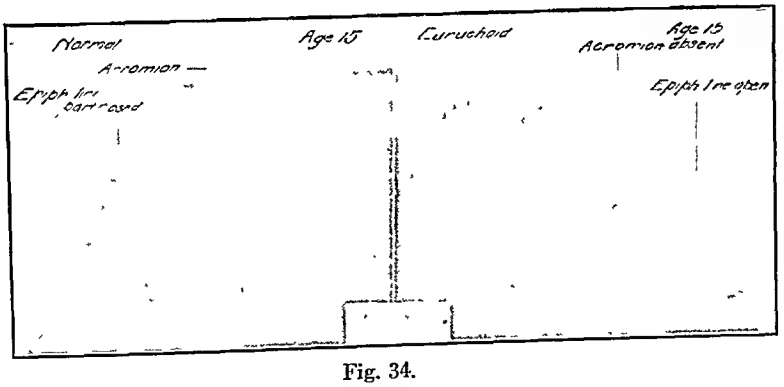

Fig. 34.

The radiograms in Fig. 40 are those of the same hypogonad subject taken after an interval of one year. The outstanding feature is a persistence of all epiphyseal lines of femur, tibia, and fibula at the age of twenty. There apparently has been no tendency for the epiphyseal lines to close in the interval elapsing between the first and second radiograms, taken at 19 and 20 years respectively. The delay in closure of the epiphyseal lines is seen in all the long

a hypogonad subject aged 20 are contrasted with those of a normal subject aged 16. In the latter the epiphysis of the olecranon is closed and the head of the radius practically closed. In the former the epiphyses are open.

The pelvis in Fig. 42, showing the head of the femur in a hypogonad subject of 20, gives additional evidence of the delayed closure of the epiphyses, and contrasts

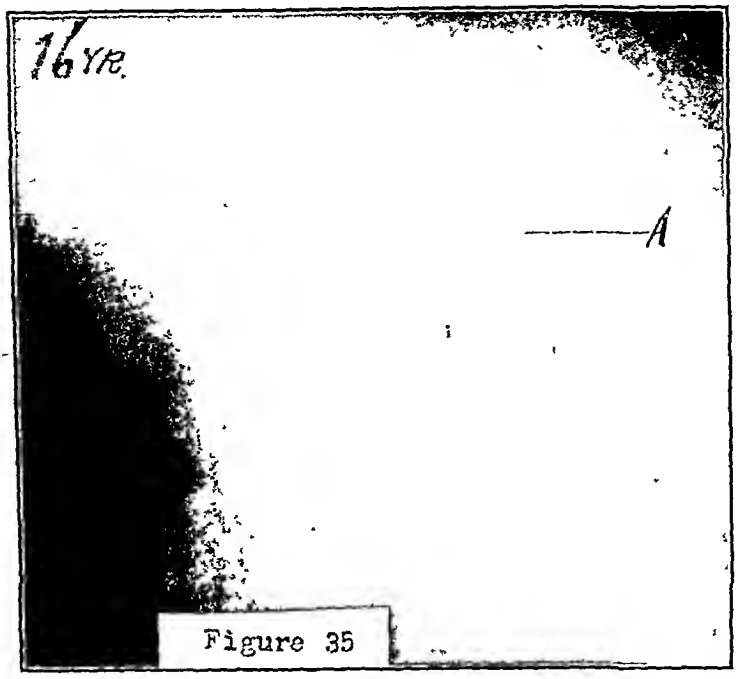

Fig. 35 Bilobar hypopituitarism, aged 16. (A) Crest of ilium well developed (normal at 15).

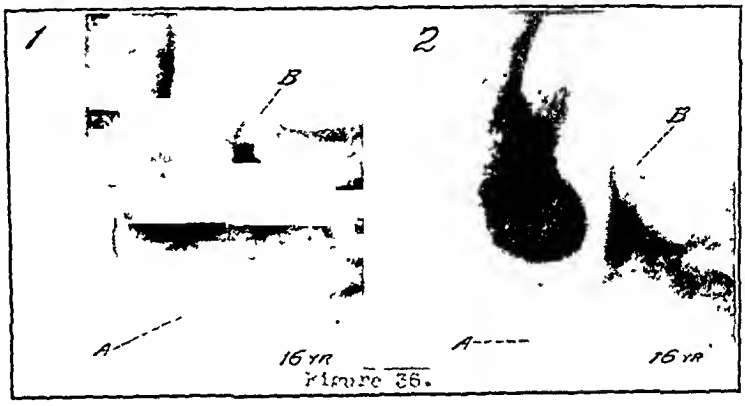

Fig. 36. Aged 16. (1) Normal, showing (A) olecranon closed; (B) head of radius closed. (2) Hypopituitarism, preadolescent, showing (A) olecranon open; (B) head of radius open.

strongly with the suspected hyperpineal subject of 15 on the right, in which all epiphyses are closed, a point emphasized in the earlier figures. The clinical types differ markedly in somatic and genital development.

Aged 24. In Fig. 43 the hand of a hypogonad subject aged 24 is contrasted with that of a normal subject aged 21. The same characteristics of hypogonad development, the size and type of hand, the open epiphyses, etc., as manifested in the above comparisons, are evident in the picture on the right. It is to be noted that the hypogonad patient in this figure is four years older than the hypogonad patient shown previously, and yet there is no evidence of closure of the epiphyses.

In Fig. 44 we compare a hypogonad hand, aged 24, with that in a case of anterior lobe pituitary deficiency at the age of 21. The difference in size of the hands is manifest. In the hypogonad subject we have the slender, artistic "eunuchoid" hand, while in the anterior lobe deficiency we have the small, fragile hand, the type "en petite." In both, we have a persistence of the epiphyseal lines. In the former we have overgrowth of the long bones, and in the latter underdevelopment of the long bones. Clinically, the types are distinct. The size of the hand, apart from the stature and general bodily configuration, is suffi-

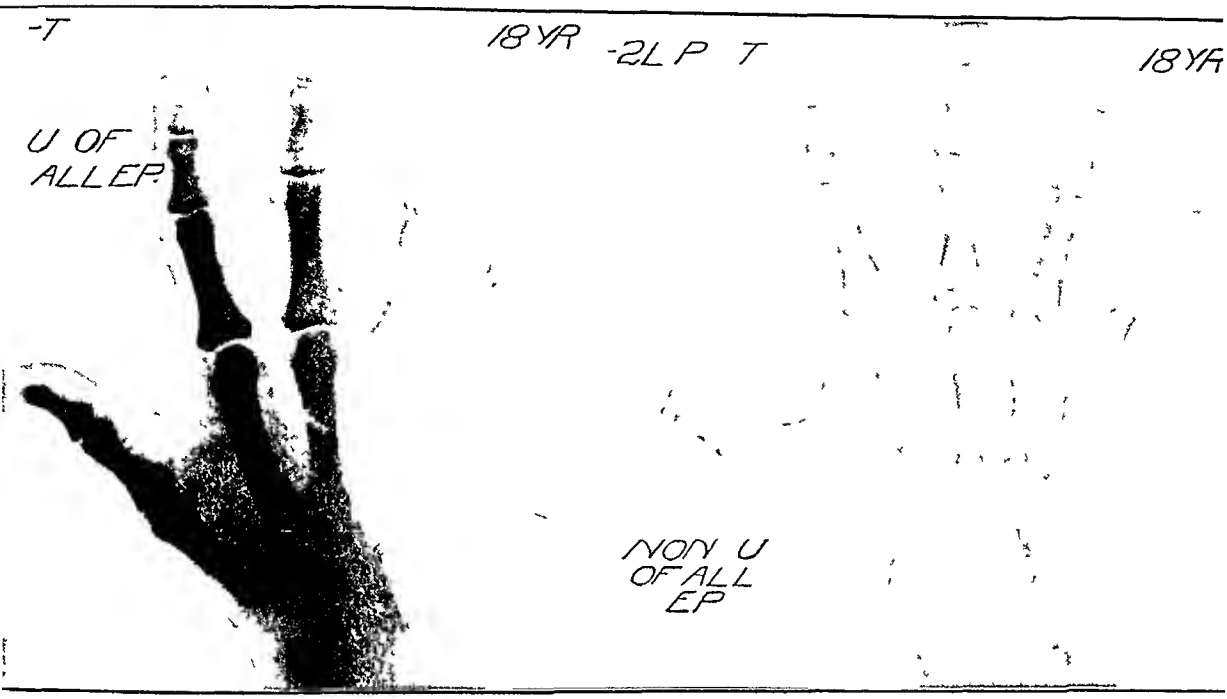
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Fig. 37

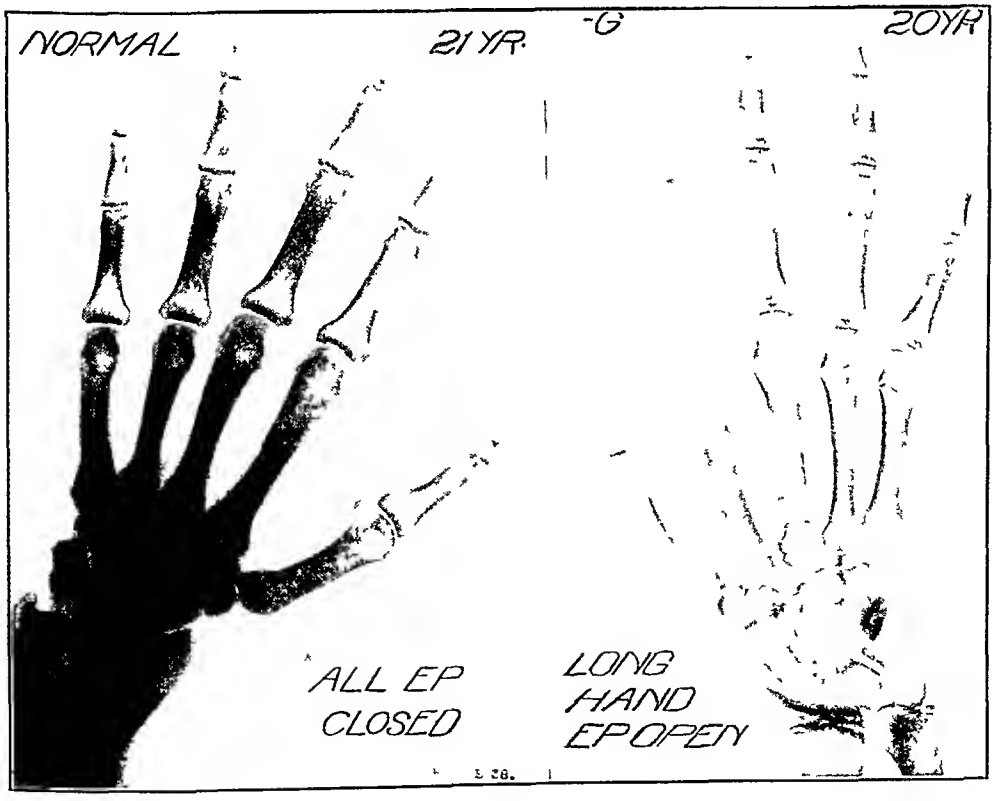
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Fig 38

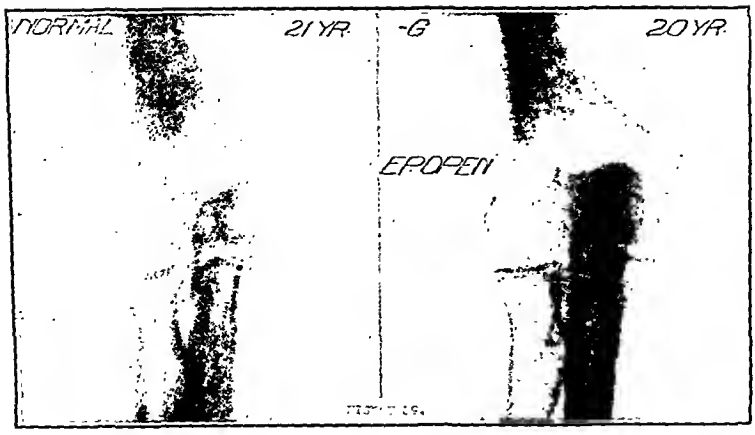

Fig. 39.

Fig. 40.

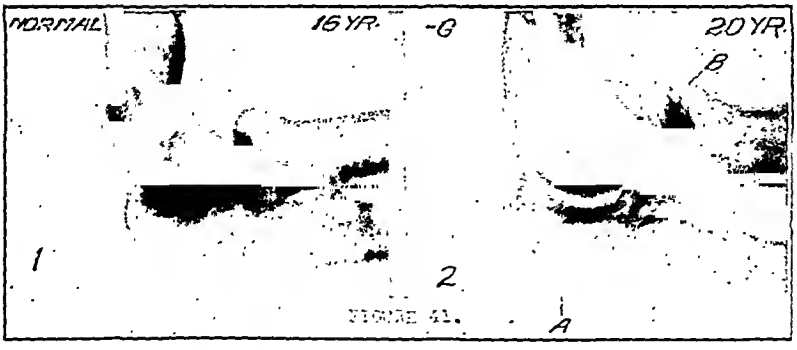

Fig. 41.

cient to differentiate the two types, although the epiphyseal lines are persistent in both.

Aged 24 and 20. A comparison of two hypogonad hands is seen in Fig. 45, both hands of a classical type, with the epiphyseal lines clearly open three to six years beyond the normal age.

Aged 21. The radiograms of the knee joints of a subject, aged 21, with anterior lobe pituitary deficiency and a subject with hypogonadism, aged 20, display the characteristics which have been evidenced in the above figures, in the persistence of the epiphyseal lines seen in the hands and other long bones. There is a marked difference, however, in the size of the long bones and the size of the corresponding epiphyses.

The normal subject, aged 21, in Fig. 47 shows complete closure of the epiphyseal line of the head of the humerus, this normally closing about the eighteenth year. In the anterior lobe pituitary deficiency

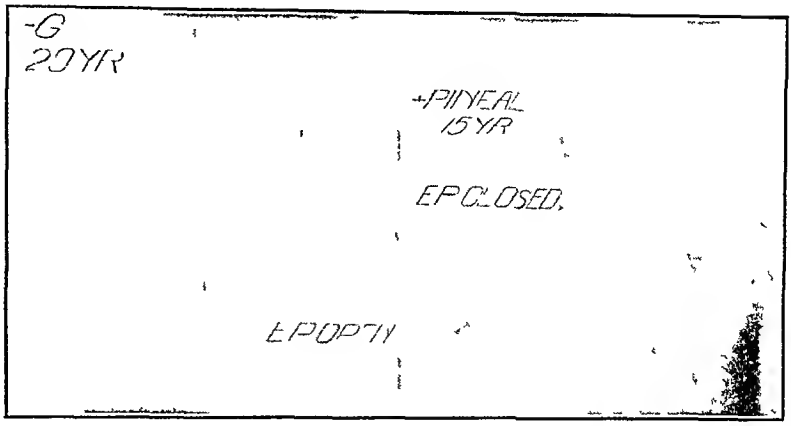

Fig 42.

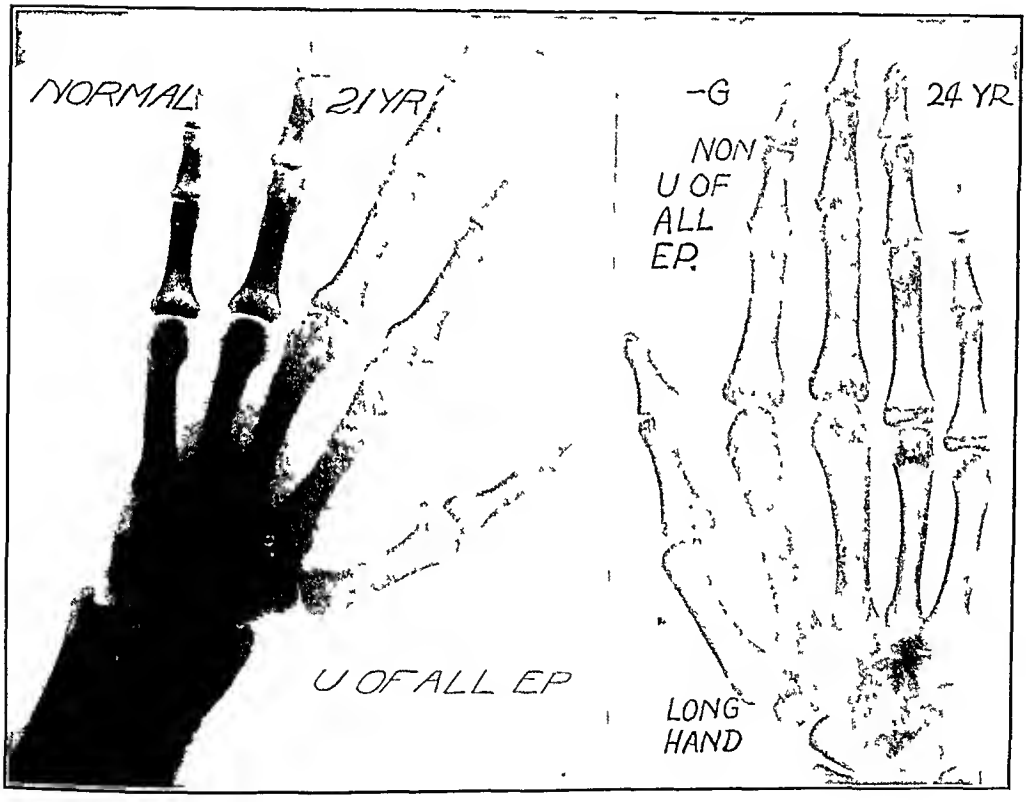

Fig 43.

there is a persistence of the epiphyseal line of the head of the humerus.

In Fig. 48 the osseous development of the knee in anterior lobe deficiency at the age of 21 is seen to be that of about ten years. There is a close resemblance between these radiograms, as evidenced in the epiphyseal lines, size of the bones, etc. The lines of ossification are to be noted in the normal 10-year knee on the left.

Acromegaly. In Fig. 49 note the characteristic spade hand of the acromegalic, showing the well-known tufting of the distal phalanges, with hook formation of the distal phalanx of the thumb, the prominence of the tuberosities of the metacarpals and phalanges, the increase in breadth of all bones, and the thickening of the cortex.

The radiogram (Fig. 50) of the sella turcica of the same patient whose hand is presented in Fig. 49 shows that the sella is definitely enlarged, without evidence of erosion. There is a thickening of the bones of the skull, with an enlargement of all

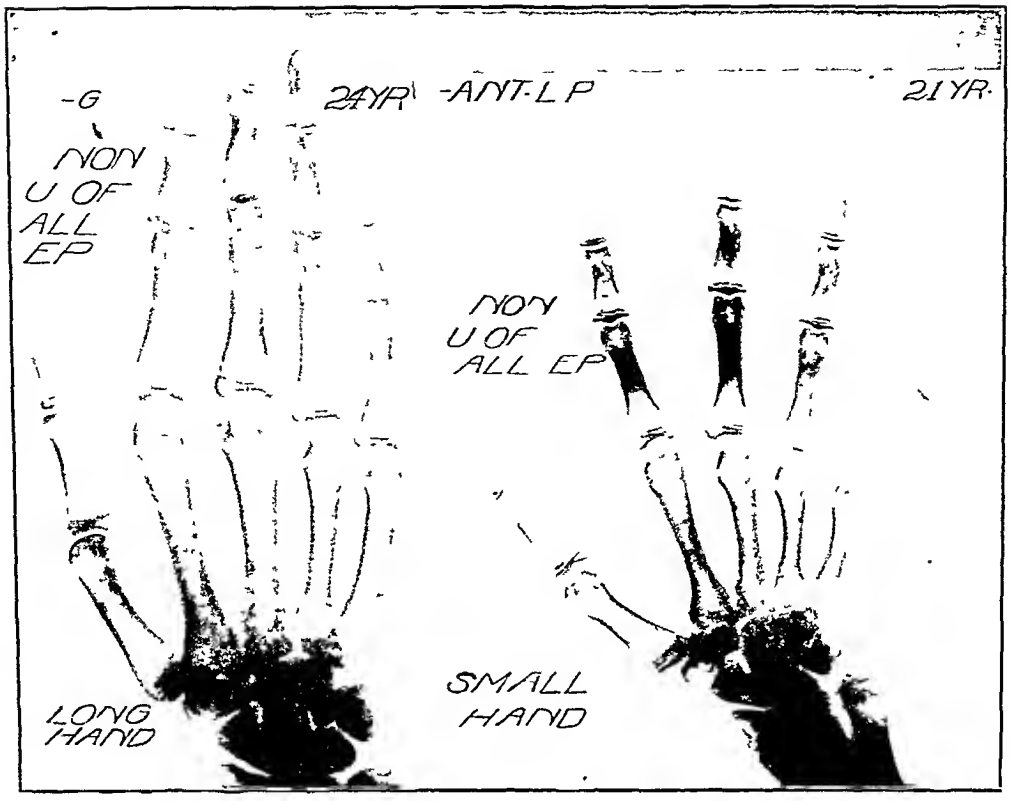
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Fig. 44.

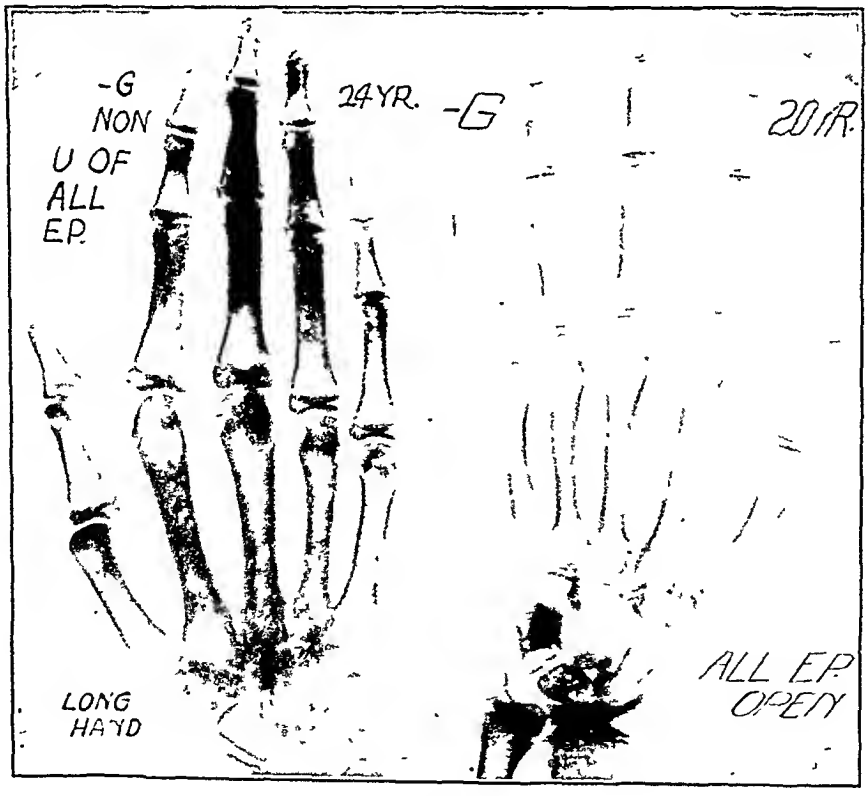
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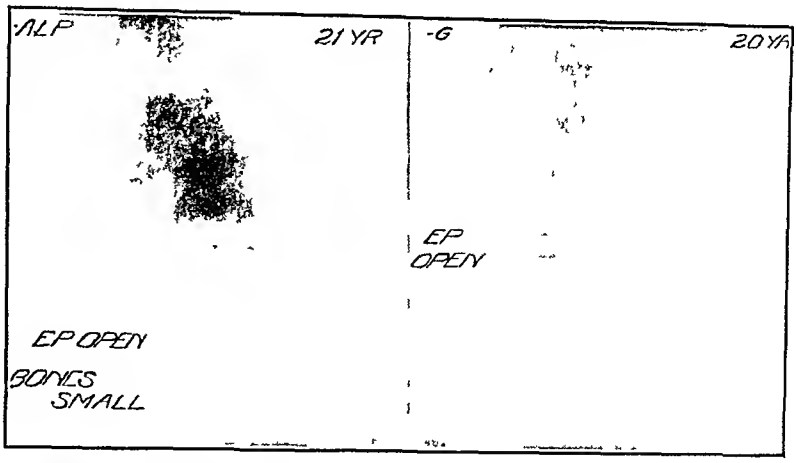
Fig. 45.

Fig. 46.



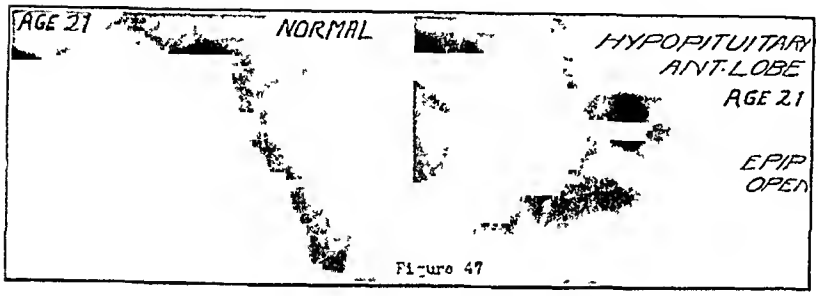
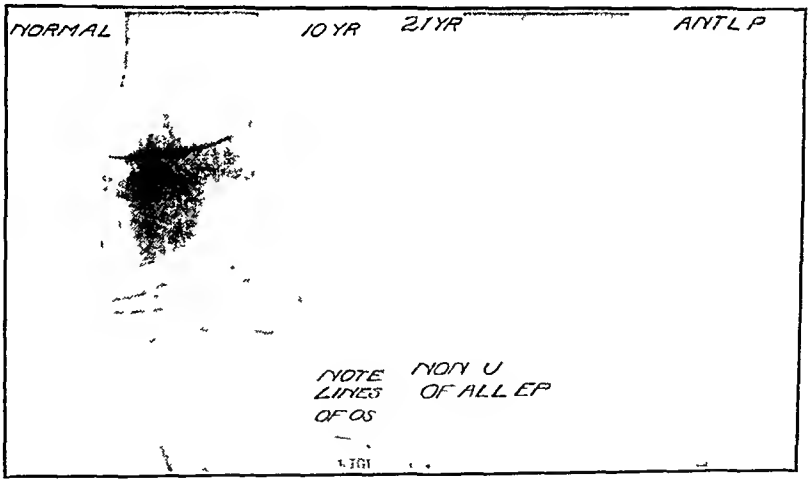


Fig. 47. Normal, aged 21, showing epiphyseal line of humerus closed. Hypopituitary, anterior lobe deficiency, aged 21, showing epiphyseal line of humerus open.

Fig. 48.



sinuses, seen particularly in the frontal sinuses.

Aged 25. The hand of a giant in Fig. 51 shows marked increase in growth of all bones. The hand is extremely large, the palm being narrow in proportion to the length of the fingers. It is to be noted that there is absence of tufting of the distal phalanges, differentiating it from the hand of the acromegalic in Fig. 49. The proportions and size also serve as differentiating factors. All epiphyseal lines are closed, although in some of the heads of the phalanges a faint epiphyseal line may be seen, suggesting delayed closure, resulting in an increase in length of the long bones.

CONCLUSIONS

(1) The general diagnostic information derived from the roentgenological compari-

Fig. 49.

-on of endocrinopathic and normal subjects has led the writers to believe that the radiological signs offer encouraging prospects of being of more value than the basal metabolism, blood chemistry, and other so-called specific and laboratory determinations.

(2) Retardation of development of all the bones of the osseous system, not only of the carpals, in uncomplicated hypothyroidism can be demonstrated roentgenologically in all ages up to that of completion of normal skeletal growth. This will be an additional aid to diagnosis in those cases already beyond the age of normal carpal development upon which basis hitherto has depended the roentgen pictures of osseous change indicative of hypothyroidism.

(3) Hypogonadism and eunuchoidism have consistently shown a definite late fusion of the epiphyseal ends of the long bones. While this has been suspected clinically, we are unacquainted with any definite roentgenological demonstration of these abnormalities in secondary hypogonadism. The late closure of the epiphyseal ends in the presence of an active hormone from the anterior lobe of the hypophysis explains the *overgrowth of the long bones* in these subjects.

(4) In anterior lobe pituitary insufficiency in which there is a primary deficiency of the anterior lobe and a secondary deficiency of the generative organs, there has been found uniformly present a late closure of the epiphyseal ends of the long bones, *associated with undergrowth* of these bones. The reason for the undergrowth of

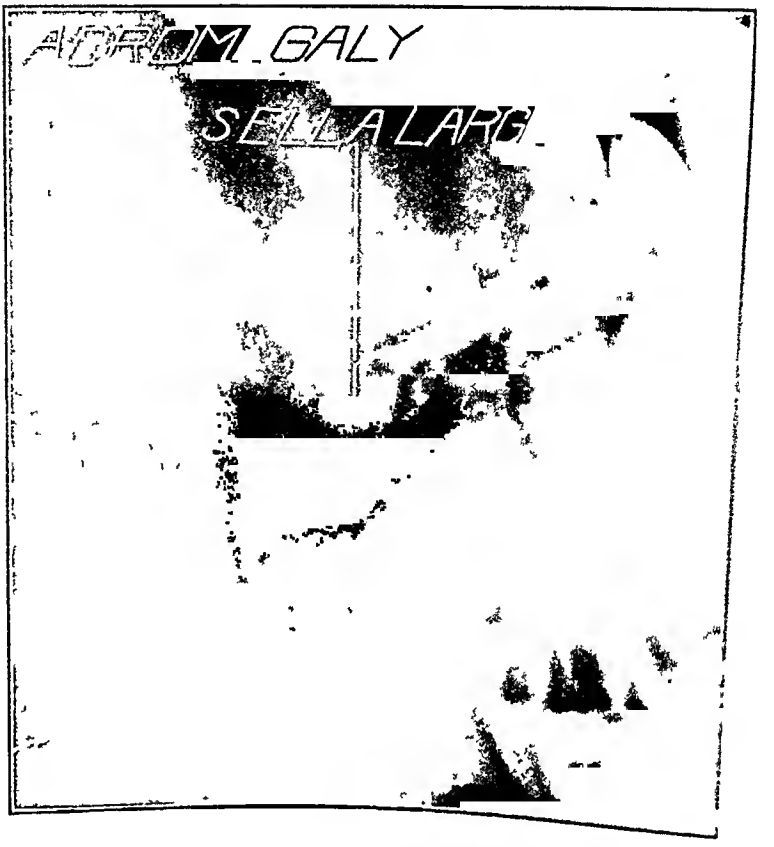


Fig. 50.

the long bones in the presence of the open epiphyseal ends in this disorder is the *absence of the hormone from the anterior lobe of the hypophysis.*

(5) In the pluriglandular syndrome, the development of the osseous system as demonstrated roentgenologically is very difficult to interpret. From the studies of our cases thus far, we are of the impression that the following facts obtain: (a) In the thyro-pituitary disorder there is an advance of the carpal and long bone nuclei development over that of pure hypothyroidism unassociated with pituitary disorder. (b) In pituitary-thyroidism, there is a retardation of the appearance of the osseous nuclei, as well as of the fusion of the epiphyseal ends of the long bones, more marked than that in pure hypothyroidism or in the normal. (c) The markedly heterogeneous pictures presented in the multiglandular syndromes will depend upon the sequence in which the various disorders were superimposed upon each other. For this reason, the combination of the same glandular disorders might present entirely different radiographic pictures of the osseous development at the same age, depending upon the order in which the various glands might have become involved.

(6) In the less frequent but very instructive condition of pubertas praecox (suspected pinealism), the most unusual advancement in development of the bone nuclei and early fusion of the epiphyseal lines was found. The four cases studied confirmed our earlier belief relative to the effect of gonad hormone upon the osseous growth and development, and were a convincing confirmation of the exactly opposite picture consistently present in the hypogonad.

(7) Thymo-lymphatism in the cases studied apparently presented the same osseous retardation as

thyroidism. The osseous development in positive cases of enlarged thymus should be more thoroughly studied, with the view of clearing up this much mooted point of the relation of thymus function to osseous development.

Fig. 51.

RENAL STONES PERMEABLE TO THE X-RAY[1]

By JOHN M. CULLIGAN, M.D., Fellow in Urology, The Mayo Foundation, Rochester, Minnesota

VARIOUS observers have noted that certain renal stones do not produce shadows in the roentgenogram, probably because of the quality of their composition. According to Walker, stones composed of calcium oxalate cast the densest shadows; those composed of calcium phosphate cast shadows slightly less dense. Pure cystin, xanthin, and uric acid stones may or may not cast shadows. The reason why shadowless renal stones are uncommon probably lies in the fact that they are usually composed of various materials including calcium.

Arcelin asserted that size and structure were very important factors in the roentgenographic density of stones, particularly the latter. He maintained that stones may or may not cast shadows, depending on the compactness of the molecules, even though the chemical composition is the same. Certain observers have noted that cystin stones cast shadows, and others have noted that they do not. Whether this is owing to a difference in the arrangement of the molecules, or to the presence of other salts, is difficult to determine. It is often difficult to discover shadowless renal stones, although not impossible if one keeps in mind the fact that they do occur.

ILLUSTRATIVE CASE

Case A450053. A man, aged 51 years, came to the Mayo Clinic, December 11, 1923, complaining of left abdominal and left lumbar pain. His present illness began about 1916 with a dull aching pain in the lower left abdomen and left lumbar region. The onset was insidious, the pain gradually increasing in severity. About one year later he began to have severe, sharp attacks of left abdominal pain typical of renal colic, which required morphin for relief. The attacks came on at intervals of a week to several months, and twice afterward he noticed hematuria. He had marked day and night frequency, passing urine ten or twelve times during the day, and four or five times during the night.

There was moderate tenderness over the left kidney area. The specific gravity of

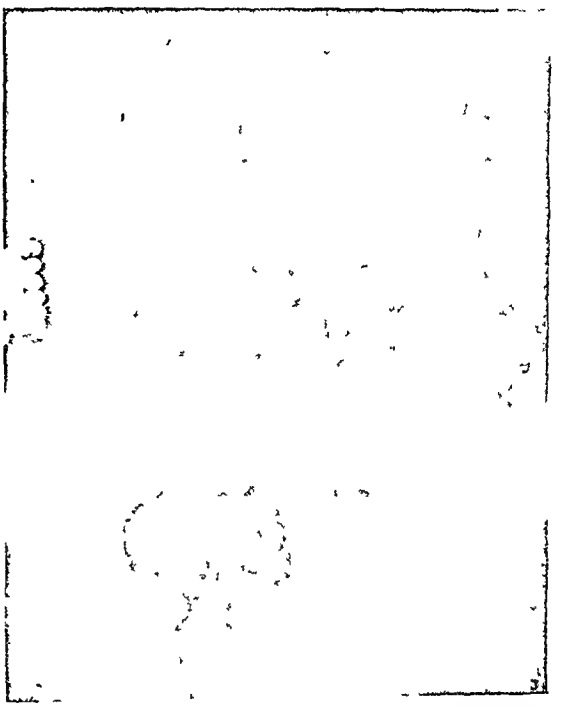


Fig. 1 (A450053). A roentgenogram of the kidneys, ureters, and bladder in the case reported which failed to show any shadows suggestive of stone.

the urine was 1.029; it was acid in reaction and contained a small amount of albumen. Microscopic examination disclosed 25 red blood cells in a low-power field and 12 pus cells. The renal function, as determined by the phenolsulphonephthalein test, was 45 per cent; the blood Wassermann reaction was strongly positive, but examination of the spinal fluid was negative. Several roentgenograms of the kidneys, ureters and bladder were reported to be negative (Fig. 1).

Cystoscopic examination revealed a moderately enlarged median bar prostate. The left ureteral orifice was gaping, and slightly turbid urine was coming from it. Both

[1]This paper is published simultaneously by the *Journal of Urology*, Johns Hopkins University, Baltimore, by special arrangement.

ureters were catheterized without difficulty, and 8 c.c. of urine was withdrawn from the pelvis of the left kidney; it contained a few pus cells. A specimen from the right kidney was microscopically negative. A differential functional test showed that both kidneys were functioning equally and normally. A pyelogram of the left kidney, made by injecting 12 per cent sodium iodide solution, revealed a peculiarly irregular-shaped pelvic outline with an area of relatively greater translucency in the center (Fig. 2). The outline of the pelvis surrounding this area was much more dense, although the calyces were not completely filled. This area of greater translucency in the portion of the pelvis which normally should contain more of the pyelographic medium than the thinner calyces, and which, therefore, should be most dense, suggested that the pelvis was filled with something more permeable to the X-ray than the sodium iodide solution. On this evidence, and the history of stone, a diagnosis of stone in the left kidney was made, and exploration advised.

Fig. 2 (A450053). Pyelogram of the left kidney showing an area of greater translucency in the center of the pelvis, suggesting that the pelvis contains something more permeable to the roentgen ray than the pyelographic medium.

At operation the pelvis of the kidney was exposed through a posterior incision. A large stone could be felt practically filling the entire pelvis. Fluoroscopy at the operating table with the kidney delivered through the incision failed to disclose shadows. The pelvis was opened, and a soft, brittle stone was removed in fragments (Fig. 3). The pelvis was lined with a sandy, stone-like material. This condition, and the failure of the fluoroscope to show whether or not fragments of stone had been left behind to invite recurrence, made it advisable to remove the kidney.

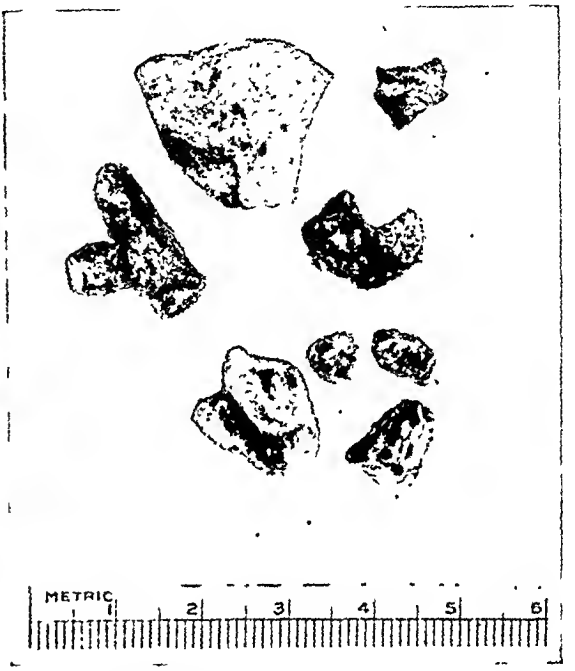


Fig. 3 (A450053). Fragments of the uric acid stone removed at operation, which did not show in the fluoroscopic examination at the operating table after the kidney was delivered through the incision.

There were eight fragments of stone, the largest measuring 2.5 by 2.5 by 2 cm. They were reddish brown, soft, and crumbled easily in the fingers. On chemical analysis they were found to be composed of practically pure uric acid and a small trace of mineral matter.

Stevens reported a case of ureteral stone composed of urates, which was negative in the original roentgenogram, and which was diagnosed by means of pyelography

which showed an area of increased translucency at the site of the stone. Graves reported two cases (one of which was cystin), diagnosed by similar areas of greater translucency, in the pyelogram. Graves, in order to satisfy himself that structural arrangement was a factor, gave a patient a capsule containing pure cystin to take by mouth. Roentgenograms made immediately failed to show any evidence of the capsule, although a bismuth capsule given at the same time as a control was distinctly revealed. This would seem to corroborate Arcelin's original contention that structural arrangement is a factor in radiographic density.

The large size of the stone in the case reported here would seem to indicate that composition and structure are more important factors than size in determining their permeability by the X-ray.

It is a well-known fact that shadowless renal calculi often produce shadows after their surface is impregnated by colloidal silver after pyelography. This means of diagnosis is no longer at our command, as most urologists feel that colloidal silver is too dangerous to use. I have been unable to find any cases in which shadowless calculi have been brought out by sodium iodid or sodium bromid.

CONCLUSIONS

1. Shadowless renal stones are usually composed of pure cystin, xanthin or uric acid.

2. Stones of such composition may produce shadows if other salts are mixed with them, or if their structural arrangement is favorable.

3. Shadowless renal and ureteral stones can be diagnosed by areas of greater translucency in the pyelogram, or the ureterogram.

4. Stones that do not cast shadows in the roentgenogram will usually not be visible when the kidney is fluoroscoped after it is delivered through the incision.

5. It may be advisable to perform nephrectomy in these cases when doubt exists concerning remaining fragments of stone.

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A DEEP THERAPY INSTALLATION EMBODYING SOME NOVEL FEATURES[1]

By W. EDWARD CHAMBERLAIN, M.D., Associate Professor of Medicine (Radiology), and R. R. NEWELL, M.D., Assistant Professor of Medicine (Radiology), Stanford Medical School, SAN FRANCISCO, CALIFORNIA

THE purpose of this paper is to describe our installation at Stanford University Hospital, which we believe excels in ease and steadiness of operation and safety for the patient.

THE GENERATOR

For the production of undirectional current at 200,000 volts we have made use of a "Rieber" booster set, but feed it 100,000 volt current rectified by valve tubes instead of by a rotating switch. This is done in order to avoid the surges which are set up by sparking in any rotary switch.

We are actually using universal Coolidge tubes instead of Kenotrons because they require only about a quarter the wattage to light. Heated to pass 10 milliamperes at a few thousand volts' drop, they will not pass more than about 50 milliamperes at full voltage. This limits any gas surges in the therapy tube, which may be important in tube life.

CONTROLS

The voltage is adjusted by means of an autotransformer feeding the four 50,000 volt transformers in parallel. Supply is at 240 volts from an individual 25 kilowatt pole transformer with 00 leads in from the street, specially installed by the power company. Thus we avoid gross voltage fluctuations due to changes in outside load.

The voltage is read by spark gap between 125 mm. spheres installed within the machine closet, but moved and read from the operator's hall outside.

The treatment tube filament is heated by a Rieber Stabilizer (not shown in diagram) and filament transformer, which gives a constant heating current irrespective of line voltage fluctuations.

The tube current is read from two milliammeters connected in series in the grounded neutral. There is also a milliammeter in one high voltage lead for a check (not shown in diagram).

Time is marked and the current cut off automatically by means of an A.C. motor and train of reduction gears, which run only when the transformer current is switched on.

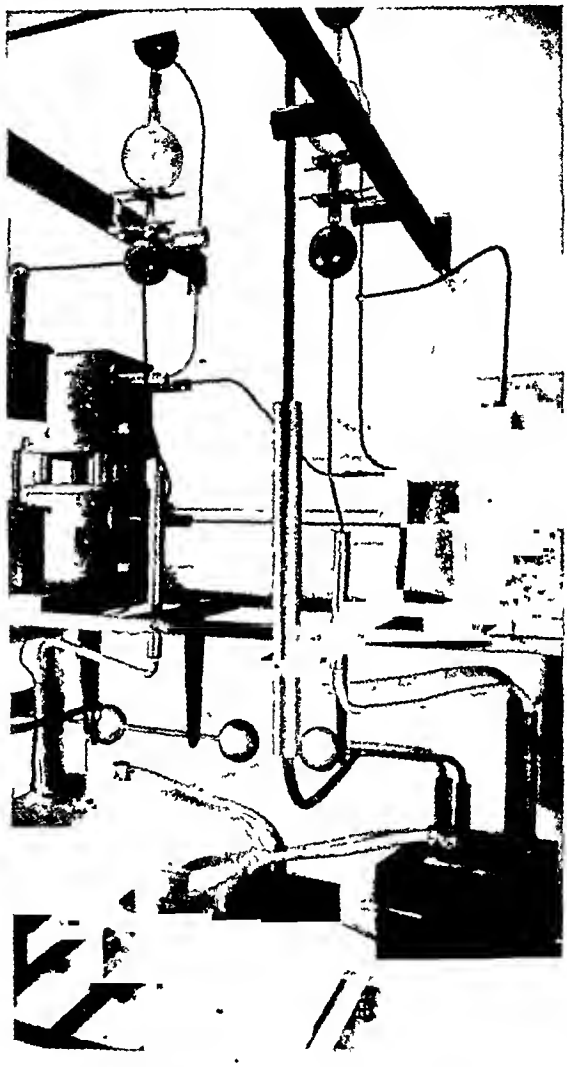

Fig. 2. Generator for production of unidirectional current at 200,000 volts.

As a final and direct check on the indirect measurement of X-ray production, there is mounted inside the tube shield, just within the filter, a small metal ionization chamber

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923.

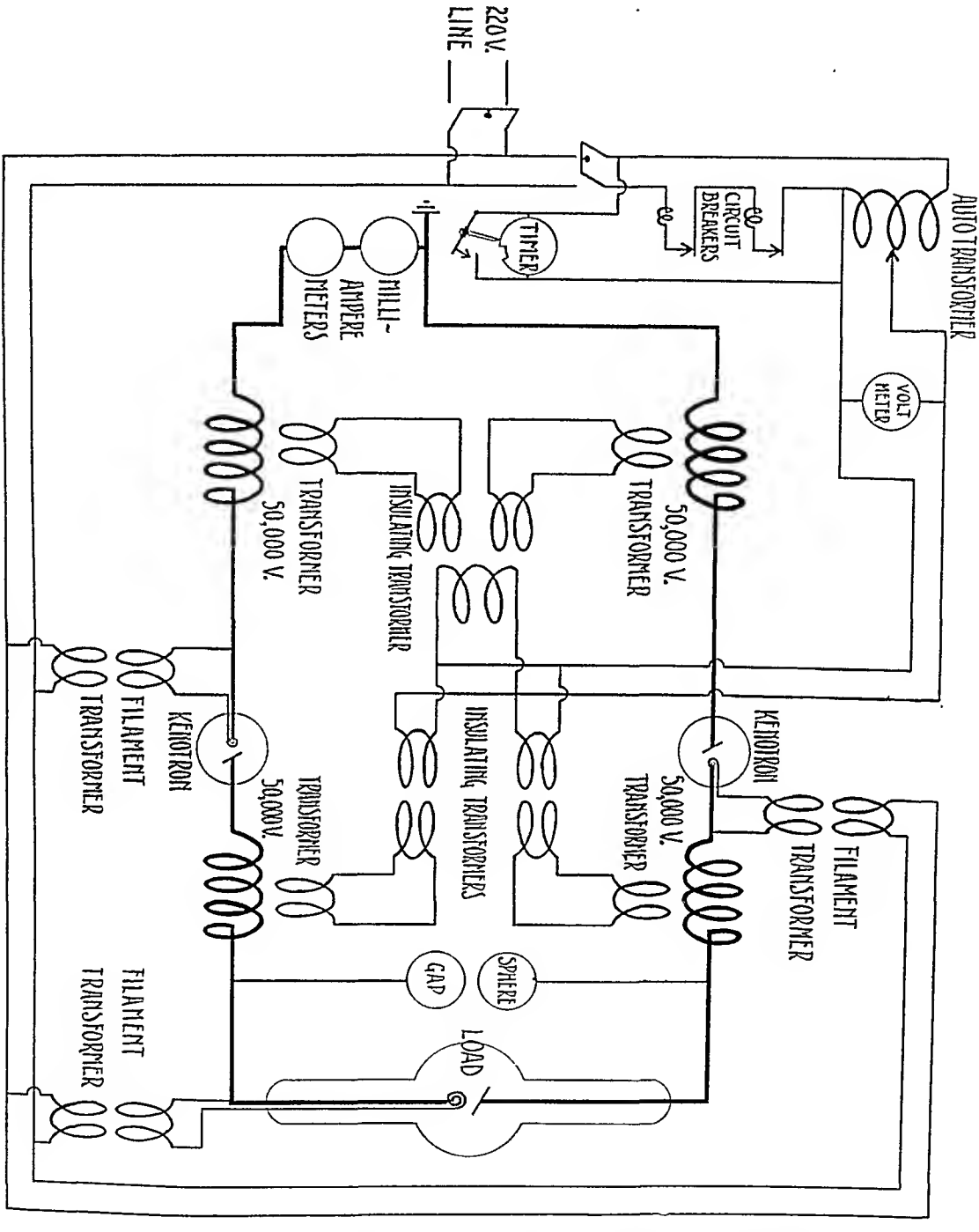

Fig. 1. Wiring diagram.

charged to 500 volts from a dry battery and connected to a sensitive galvanometer. This gives continuous readings of actual X-ray production.

THE PATIENT

Complete X-ray and electrical protection for the patient has been attained by mounting the tube in the axis of a drum lined with ¼ inch of lead and by enclosing the high voltage leads completely. In order to obtain maximum flexibility in use, the high voltage current enters the drum at the ends, so that it can be rotated through 360° and treatments conducted through a port in the side of the drum with the patient below, above or at the side.

The couch is on castors and has an up-and-down adjustment on notched posts of

16 inches. To provide for long focus skin distances when the patient is underneath, the tube is mounted high. This necessitates raising the patient rather far toward the ceiling when the back is to be treated. A hand-operated travelling crane does this easily and quickly without necessity of any exertion on the patient's part. Whether treated from above or from below it is easy to obtain focus skin distance from 31 to 90 cm.

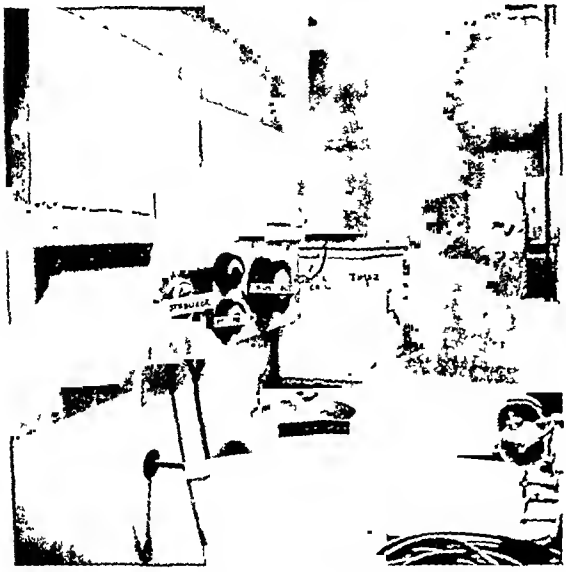

Fig. 3. Operator's hall and instruments.

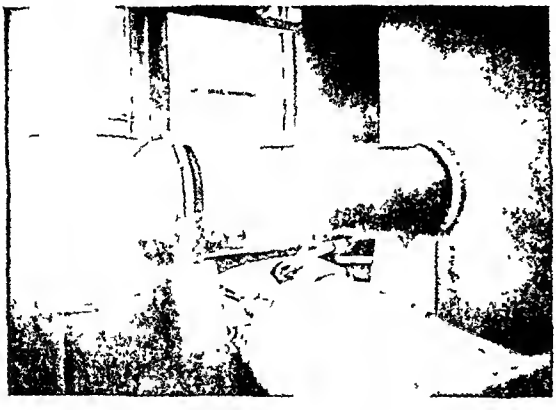

Fig. 5. Patient being treated from above

The patient is adjusted under the tube roughly by eye and the position checked by exploring the edges of the X-ray illumination with a piece of intensifying screen mounted in the end of a long, light-tight, one-inch tube. When above the tube, the field of X-ray illumination is found by laying on top of the patient a piece of celluloid of the proper port size and then centering by means of a plumb-bob hung in the central ray.

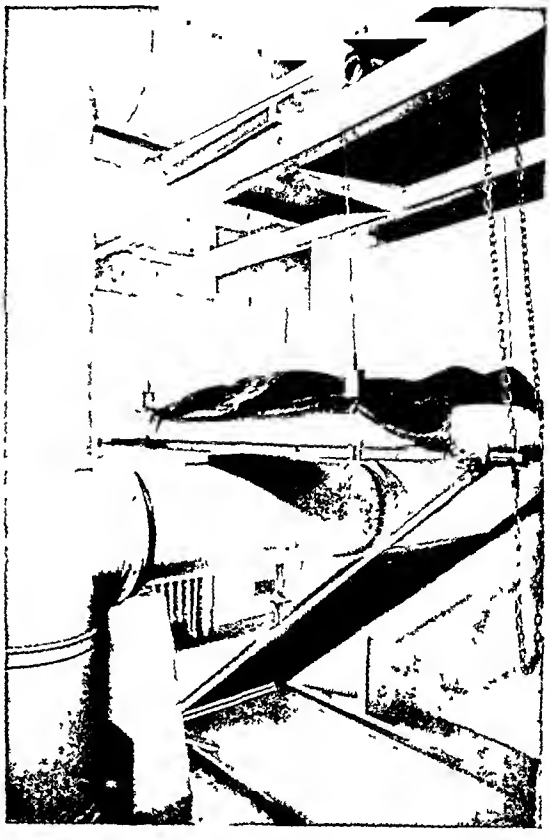

Fig. 6. Patient being treated from below.

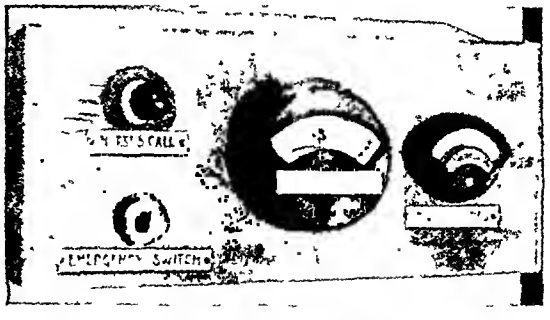

Fig. 7. Remote instrument board at desk of department clerk.

A current of air is sucked through the tube shield from cathode end to anode by a ¾-horsepower blower. The patient is thus protected absolutely from any ozone

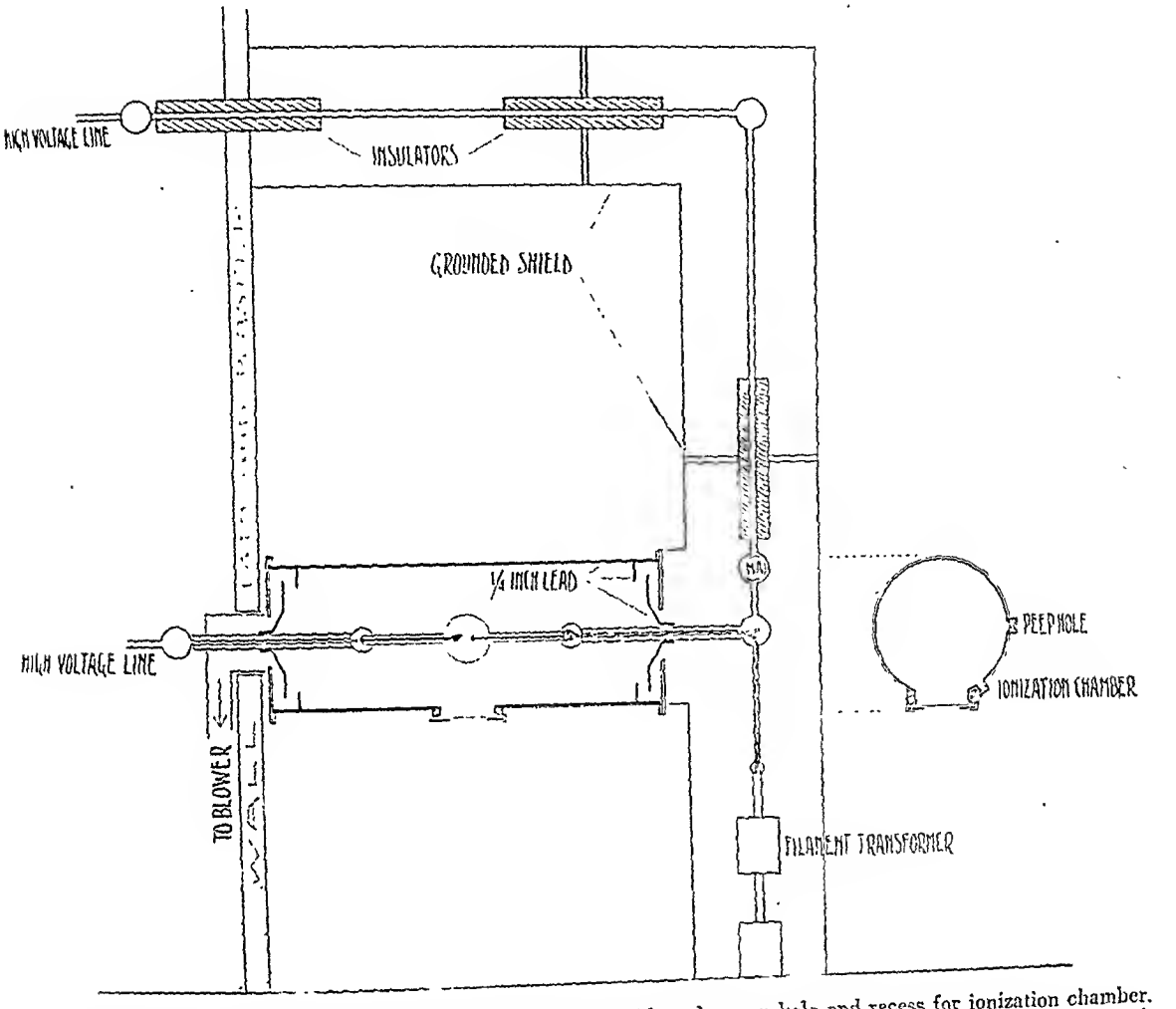

Fig. 4. Diagram of tube shield and high tension leads. (Note the peep hole and recess for ionization chamber. These are lacking in our present tube shield, so that we have to do without the first and have had to place our ionization chamber in one side of the treatment nozzle, where it is still shaded from scattered ray from the patient by the lead diaphragm, however.)

or oxides of nitrogen, and the tube is cooled in a very efficient manner.

EMERGENCIES

Two quick-acting circuit breakers shut down the transformers in case of serious electrical accident, as a short circuit, a punctured tube, or if the line voltage should climb to give over 250,000 volts on the tube, at which value the safety gap is set. This also shuts off the timer so that no mistake will be made in the amount of treatment remaining to be given (see Fig. 1).

The patient has a push button which lights a signal at the desk of the department clerk. To this desk are run also extension leads for milliammeter and primary voltmeter.

RESULTS

The installation runs at such an even level of voltage and milliamperage that constant attendance is not necessary, and the patient is habitually left alone or with only his family or friends throughout the entire treatment, one of us coming in every quarter of an hour or so to see that everything is all right.

The treatment room is free from any "electrical" odor whatever and remarkably quiet.

Electrical protection is perfect, so that even the most ignorant parent or the young-

est child may be permitted to stay with the patient during his treatment *without supervision*. X-ray protection is so nearly perfect that the radiologist may safely visit his patient while the treatment is going on. No lead protection is used on the walls of the room or control hall. A lead rubber sheet is usually thrown over the patient while being treated from below, in order to remove any possibility of cumulative effects on those employed on the floor above. There is nothing but the earth beneath.

With all this protection, nothing has been sacrificed of flexibility. Raising and lowering even the heaviest and most helpless patient and adjusting the distance and direction of radiation are easy and quick.

SUMMARY

A deep therapy installation is described which contains the following features:

1. Two hundred thousand volts rectified by Kenotrons, half the wave being utilized.

2. Voltage and current control so even that constant attendance is unnecessary.

3. An electrically driven timer.

4. Continuous direct measurement of X-ray production.

5. Enclosure of the tube within ¼ inch of lead, the cylindrical shield being capable of 360° rotation.

6. Complete enclosure of high tension leads.

7. Travelling crane for lifting patients who are to be treated above the tube.

8. Remote instrument board for discovery of emergencies.

Pleurisy.—The physical and roentgen symptoms differ according to the localization of the exudate. If the encapsulated exudate is situated in front of the root of the lung, constituting a pleuritis mediastinalis anterior, the dullness over the heart on percussion will be found increased either to the right or left, and the shadow of the heart, on roentgen examination, will be seen larger either to the right or left. Even by a roentgen examination it is not always easily distinguished from a pericarditis with effusion. All of these exudates, just as exudates in every other pleurisy, are situated in the pleura, consequently a serous exudate originally situated on the median surface of the lung, thus constituting a serous mediastinal pleurisy, can soon spread over the other divisions of the pleural cavity, when it is not encapsulated. In case the exudate is situated in the posterior mediastinal space along the spine, it causes a rectangular dullness, and a rectangular shadow along the spinal column will be seen in the roentgenogram. When the exudate spreads over the diaphragm it causes a right-angled pleurisy. The exudate may extend into the interlobar fissures, producing the so-called "carrefour hilare," as described by Barjon. In posterior mediastinal pleurisy ordinary clinical examinations fail and the diagnosis can be made by the roentgenogram.

The author has collected from the literature 26 cases, and reports one case of exudate in the posterior mediastinal space. On fluoroscopy the heart appeared to be retracted to the left and the costo-phrenic angle free. The shadow of the heart was intersected by a triangular shadow which had its top at the root of the left lung at the same level as the top of the triangular dull area elicited by physical signs. The base was on the diaphragm and situated behind the heart shadow. Aspiration revealed a small amount of clear fluid and about 100 c.c. of air. It was assumed that there existed an encapsulated mediastinal sero-pneumothorax surrounded by a thickened pleura. The disease began very likely as a circumscribed pleurisy on the diaphragm in the posterior mediastinum, and the author believed that during a coughing paroxysm a small rupture of the lung occurred and produced a local pneumothorax.

J. D. CAMP, M.D.

Pleuritis Mediastinalis. J. B. Polak. Acta Radiologica, II, 1923, p. 461.

THE LUNGS OF TUBERCULOUS CHILDREN[1]

By JOHN D MacRAE, M.D, Asheville, N. C

THIS study concerns itself with pulmonary tuberculosis, tuberculous adenopathy and bone tuberculosis, and necessarily with non-tuberculous diseases involving these tissues. Also with an ideal normal chest for purposes of comparison.

Each of the phases named above would furnish material for voluminous writing. Therefore, my consideration must be gen-

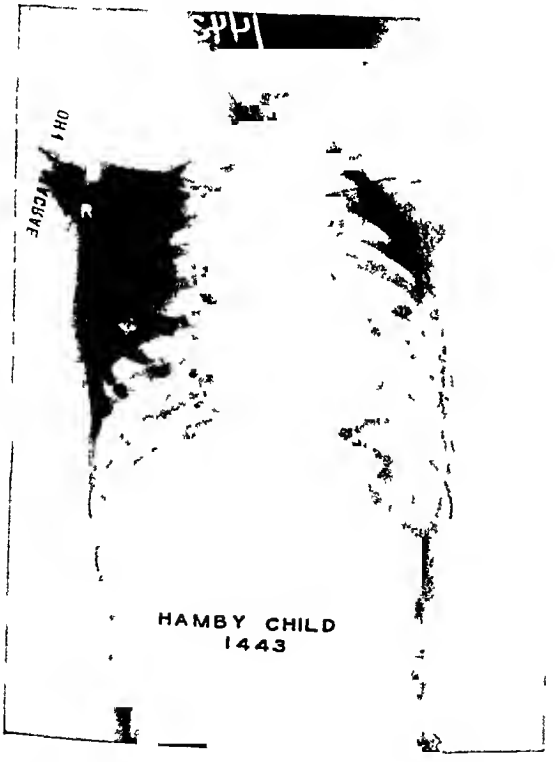

Fig 1. Adenopathy and enlarged thymus. Status lymphaticus (Case 1443)

eral and I can present only a few features in particular.

Pediatricians, general practitioners and various specialists are confronted daily with obscure conditions in children where tuberculosis must be excluded or recognized in relation to the patient's symptoms. They call on us for help in solving the problem. Such help as I can give is sometimes disappointing and I find it necessary

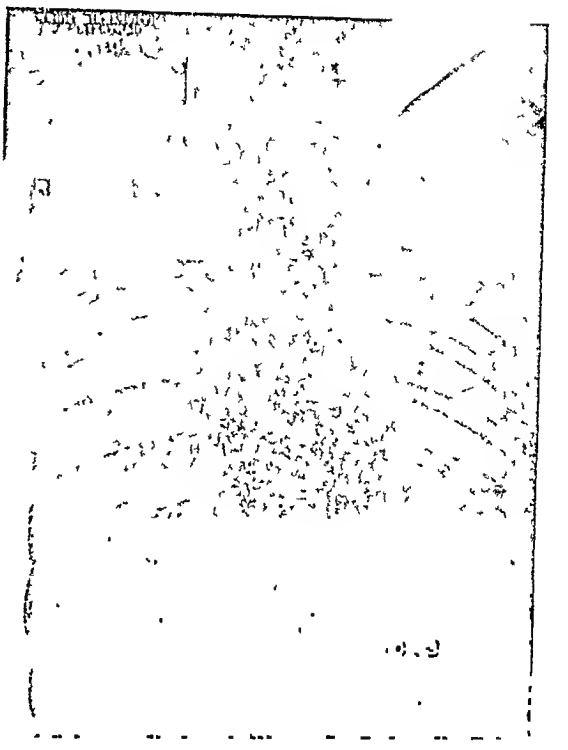

Fig 2 Adenopathy with calcified lymph nodes, secondary to non tuberculous osteomyelitis (Case 1043)

Fig 3. Adenopathy and calcified hilum lymph nodes. Patient has a tuberculous hip joint. (Case 1052)

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, December, 1923

to give more study to the question in order that my X-ray opinions may have real value.

While in the Army, on duty in a tuberculosis hospital, I made stereoscopic films

Fig. 4. Widely disseminated caseous tuberculosis. Patient died at four months. Was born of a tuberculous mother who never nursed the child. Child was sick from birth. (Case 1019 P. M.)

of the chests of a hundred men between 20 and 30 years old who were selected as being healthy individuals. in an effort to secure a normal chest for purposes of comparison. There were evidences of pathologieal change in practically every one of them. Since that time I have studied the X-ray films of the lungs of children from one to two hours old to puberty with the same purpose in view. Like others who have pursued similar studies, I have yet to find a normal chest in man or child, but carry in my mind an ideal which is more or less like the composite roentgenogram of a child chest as given us by the committee of the American Tuberculosis Association in their report of May 6, 1922.

The American Tuberculosis Association's Committee made its study on the lungs of children between the ages of 6 and 10 years. By the time a child is 6 years old he has generally experienced enough of

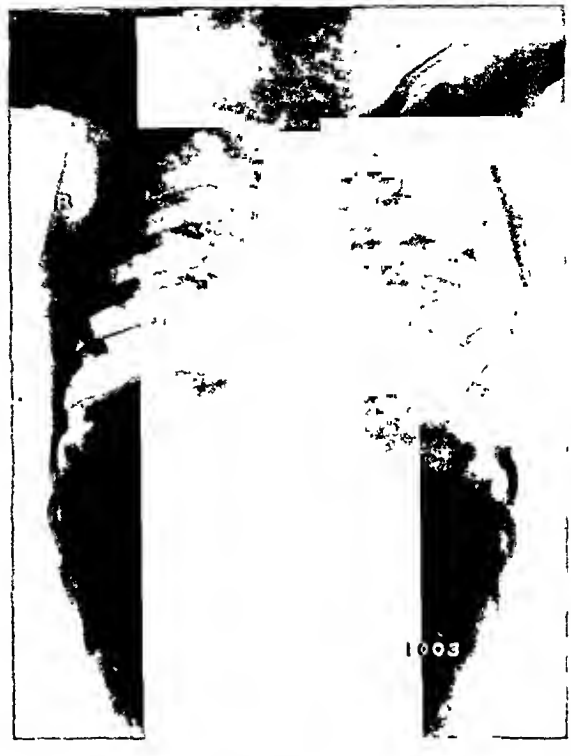

Fig. 5. Adult type of fibroid tuberculosis. Patient eight years old; has a tuberculous knee joint. (Case 1003.)

sickness and inhaled enough dust to produce recognizable changes in the tracheobronchial and bronchial lymph nodes at the lung root. We are more troubled to put a correct valuation on these changes than anything else in this work.

The hilum of the lung, as shown by X-rays, is made up of thick-walled bronchi, blood-filled vessels, lymph nodes and connective tissue binding them together. The hilum shadow becomes larger and denser from birth onward, in direct proportion with the amount of dust inhaled and the extent of the individual's pathological experiences.

In examining the chest films of 150 children at the North Carolina Orthopedic Hospital last year, calcified nodes were noted

in the hila of some who were less than 2 years old. Some had tuberculous bone lesions; some osteomyelitis, non-tuberculous; some syphilis, and many had the deformities of infantile paralysis. It was striking to note that the patients who had destructive bone lesions showed the greatest amount of calcification in the lymph

Fig. 6. Circumscribed caseous tuberculosis in left chest, displacing heart to right. There are smaller scattered caseating tubercles. Patient died at age of six months. Born of tuberculous mother and was sick from birth. (Case 1468 P. M.)

Fig. 7. Lungs removed from thorax and inflated, showing massive caseation and numerous scattered caseous lesions. (Case 1468 P. M.)

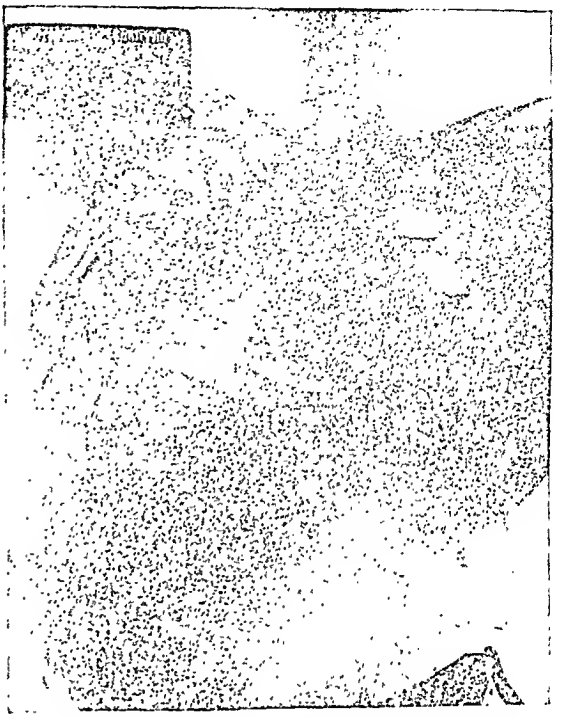

Fig. 8. Deformed chest; infantile paralysis; clear lungs. (Case 1032.)

nodes at the lung roots, and that calcification was just as pronounced in the patients with non-tuberculous osteomyelitis. The cases of infantile paralysis showed the most inconspicuous hilum shadows.

None of these children had chest X-rays made because of pulmonary symptoms. Several were found to have tuberculous tracheo-bronchial adenopathy, which accompanied clinical evidences of the disease, and the diagnosis was made by co-relating X-ray and clinical evidences. A greater number of these children had hypertrophy of the tracheo-bronchial lymph nodes secondary to mumps, measles and whooping cough. Tuberculosis was excluded in these cases by history and clinical manifestations. We are here confronted with another striking fact, namely, the lymph-adenopathy of non-tuberculous origin may present the

same appearance as tuberculous lymphadenopathy.

Bone tuberculosis is mentioned because of the fact that in its presence there is to be seen a greater amount of calcification in the hilum lymph nodes than where no bone destruction is taking place. At the same time attention is called to the fact that where bone destruction from non-tuberculous disease is going on we will note the same calcium deposit at the root of the lungs. It seems that when an excess of calcium is in the blood the lymphatic glands at the root of the lungs have a special tendency to take up calcium, as shown in X-ray films.

Fig. 9. Deformed chest; infantile paralysis; clear lungs. (Case 1040.)

Fig. 10. Calcified hilus lymph nodes. Deformed chest on account of tuberculous spine. (Case 1002.)

Pulmonary tuberculosis in the very young is fatal in a large percentage of cases. In the past we were taught that practically all infants contracting the disease within the first year died tuberculosis deaths. There is reason to believe that this was an exaggerated view, for there are to be demonstrated healed lesions in the lungs of infants so young that these lesions must have had their beginnings within the first year of life. In spite of the fact that calcification may be the result of pathological processes other than tuberculosis, it is pretty generally held that tuberculosis accounts for most of it.

Tuberculosis is looked upon as being a disease of lymphoid tissue, and as this tissue is present in abundance in the very young it is natural that adenopathy is the common manifestation. However, pulmonary lesions are demonstrable very early in infancy. Tuberculosis is not seen distributed in lungs then as it is in adults. When it does occur in the apices and periphery of the lungs of children it is classified as of "adult type," and is found in children about the twelfth year, occasionally in younger children.

The infantile type which so often proves fatal probably spreads to the lung from conglomerate tubercles in the hilum, breaking down and being spread by aspiration

into bronchi, producing caseous bronchopneumonia in the lungs near the hila, or the tubercle breaking into a blood vessel is disseminated in the blood current, producing miliary tuberculosis of the lungs and other tissues.

It is wrong to accept a final diagnosis in the pulmonary diseases of adults which is based on X-ray evidence alone, but tuberculosis in children's lungs presents even greater difficulties. I have known of many instances where X-ray findings of lymphoid hypertrophy at the hila, with or without calcified nodes, have been offered as conclusive evidence of tuberculous disease, where clinically such a diagnosis could not be supported. It is absolutely necessary to correlate the result of physical examination and history before a diagnosis can be made. If a child is losing weight or remaining at a standstill, shows ready fatigue-ability and reacts positively to the tuberculin test, and if, in addition, tracheobronchial hypertrophy can be demonstrated, the case is almost certainly tuberculosis.

SUMMARY

1. The appearance in X-ray films of the chest of lymph-adenopathy may be the same in non-tuberculous diseases of childhood as in tuberculosis.

2. Calcification occurs in lymph nodes of hila in the presence of chronic bone destruction, as osteomyelitis, in abundance, and is not necessarily evidence of obsolete or arrested tuberculosis.

3. Tuberculous disease must not be diagnosed on X-ray evidence except it be correlated with history and clinical findings.

Tuberculosis, its diagnosis, symptoms, and treatment.—All pulmonary tuberculosis has its inception in infancy and childhood as a glandular infection, and the adult manifestation is but a metastatic expression of an infection incurred in the earliest years of life.

A careful history is one of the greatest assets one has in making an early diagnosis of tuberculosis. Among the predisposing factors the author accords fatigue, mental or physical weariness, a place of much prominence. Four elements stand forth as frequent offenders in the causation of physical fatigue; namely, faulty ventilation, lack of sleep, chronic foci of infection and lack of muscular exercise. In the causation of mental fatigue he mentions worry, fear, jealousy and hate, the latter two only when drawn out over a considerable time. He also believes that the libido in adolescent youths should be listed among the predisposing factors.

Among symptoms he gives the following in order of frequency: Bloody expectoration, pectoral pain, shortness of breath, fatigue or lassitude, with loss of weight, chilliness in the morning with flushing in the afternoon, and an occasional general body sweat at night.

The most prominent physical signs include lagging on inspiration, increased density on palpation, muscle rigidity (spasm), respiratory changes, i. e., alteration in rhythm and change in pitch, râles. The author believes that rough breathing is of paramount importance, both from the standpoint of early occurrence and of diagnostic significance.

In the author's personal experience, he has found the X-ray of aid, both material and frequent. In the absence of definite physical signs in the obscure hilus type, the X-ray has been invaluable. In apical lesions his observation has been that practically all cases which have arrived at the stage admitting of râles registered definite X-ray evidence. With apical lesions in the pre-râle stage, and physical findings limited to the barest respiratory changes, the X-ray furnished unsatisfactory and unreliable help in the majority of instances. He says, however, that he can without difficulty recall several instances in which a diagnosis was not even suggested by the physical evidence and yet was definitely established by means of a careful roentgen-ray examination. In the differentiation by means of the X-ray of a quiescent or healed from an active focus, he has seen only mediocre results. He thinks tuberculin occupies a definite place as a diagnostic aid. He also mentions the necessity of oft-repeated examinations of the sputum.

W. J. MARQUIS, M.D.

The Early Diagnosis of Active Pulmonary Tuberculosis. R. S. Berghoff. Am. Jour. Clin. Med., Feb., 1924, p. 83.

X-RAY STUDIES OF FUSO-SPIROCHETAL INFECTIONS OF THE LUNGS[1]

By I. PILOT, M.D., from the Department of Pathology and Bacteriology, University of Illinois College of Medicine, Chicago

FUSIFORM bacilli and spirochetes were among the first bacteria demonstrated in the mouth, especially about normal and carious teeth. Our studies in the distribution of these organisms have shown that they are also present in a considerable percentage of normal individuals in the crypts of the tonsils and in the naso-pharynx. Under certain conditions they become pathogenic and cause various lesions. We usually think of these anerobes in connection with Vincent's angina, but we have demonstrated their presence in putrid and necrotic processes, particularly in ulcerative stomatitis, foul abscesses of the teeth, in the foul discharges of chronic otitis media and sinusitis. In the condition known as "noma" they produce a gangrenous lesion in the mouth. The striking characteristic of the lesions is the putridity and often necrosis. Our attention was then drawn to the foul expectoration in certain pulmonary conditions and we found that these organisms play an important rôle in the production of the necrotic lesions associated with abscess, bronchiectasis and gangrene.

Pulmonary infections from aspiration of mouth and throat secretions following tonsillectomy or general anesthesia for other operations, from foreign bodies in the bronchi, and perforations from esophageal carcinomata can readily be unders The material aspirated in such ins contains streptococci, fusiform bacil spirochetes and perhaps other bacter the lungs they set up an inflamma action with the formation of single tiple areas of suppuration or Less easily explained are the lesio ently of the same character and same organisms that arise more following bronchitis, pneumonia a few, without demonstrable cau pulmonary tissue already a tuberculosis, carcinoma, or br may be secondarily involved i

Fig. 1. Lung abscess following ether anesthesia.

Fig. 2. Multiple abscesses of the lung.

[1]Read before the Radiological Society of North America, at Rochester, Minnesota, De

process. In some, the development is acute, with either complete resolution or further spread as a more chronic process. Others are apparently a low-grade subacute or chronic process from the beginning, with patients with foul expectoration, although physical signs may be wanting. The sputum is usually characteristic. In abscess and bronchiectasis it forms three layers; in gangrene it is more liquid and green; in

Fig. 3. Pulmonary gangrene following ether anesthesia.

Fig. 4. Pulmonary abscess before neosalvarsan treatment (Case 4).

periods of acute symptoms as fresh areas become involved.

The fusiform bacilli and spirochetes are associated with pyogenic organisms, usually streptococci, and all combine in the production of the lesion in the form of an abscess or gangrene. The clinical picture is usually that of a gradual onset with cough, pain in chest, temperature rise from 100° to 103°, beginning in the aspiration types three to six days after anesthesia or other definite cause. Foul expectoration usually begins on the twelfth to fourteenth day. Physical examination may reveal signs of pathology in the lobe, but often the findings are indefinite. In these cases the X-ray has been of great assistance, not only in the diagnosis of a lesion, but also in the study of the behavior and course of the process. Thus far we have not failed to demonstrate a lesion in the lung with the X-ray in all all, the odor is foul. Smears made carefully of the washed sputum stained with dilute carbol-fuschsin, or by the Fontana method, reveal streptococci, fusiform bacilli, and spirochetes similar in morphology to those found about normal teeth and tonsils. In cultures, the cocci are generally streptococcus viridans, which are often anerobic, and, in a few, streptococcus hemolyticus or B. influenzae or micrococcus catarrhalis may also be present. The fusiform bacilli are found only in anerobic cultures. While pyogenic cocci may produce abscess in the lung in the human and in the experimental animal the lesion is never putrid; when a foul lesion is produced the anerobes are responsible. As the anerobes disappear from the sputum the

odor simultaneously disappears from the sputum.

Several cases were studied postmortem. Abscesses in fatal cases were usually multiple, with areas of softening forming ab-

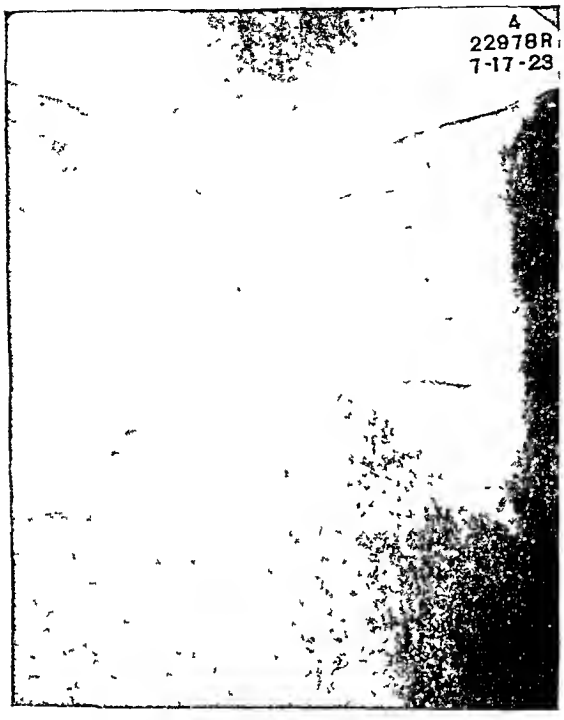

Fig. 5. Case 4, one week later than shown in Fig. 4.

scess cavities lined by necrotic walls. Gangrene was either a diffuse process or in scattered foci. In both conditions there was always associated bronchopneumonia in the more remote parts of the lung. Bronchiectatic cavitations were usually complicated by abscesses adjacent to the bronchi. Serofibrinous pleuritis or putrid empyema was not an uncommon complication. Of special interest was the bacteriology. In direct smears from the softened areas, fusiform bacilli and cocci could be demonstrated in enormous numbers. Spirochetes were also present in most cases. In sections stained by the Levaditi method, the spirochetes were most numerous at the margin of the necrotic abscess wall and appeared to be migrating into the surrounding tissue. The fusiform bacilli remained confined to the abscess wall, while cocci were found even in the more remote parts of the lung, giving rise to an interstitial bronchopneumonia.

The X-ray appearance of the lung infected with these bacteria is a variable one. I shall not speak of the mixed infiltrations that are seen in infections complicating tuberculosis and carcinoma. The type of lesion will not be new to you, as you are all familiar with the X-ray appearances of lung abscess, gangrene and bronchiectasis. The chief point that we wish to bring out is that these lesions may be considered bacteriologically as well as anatomically, and when a foul sputum is evident, in most instances the odor is due to fuso-spirochete infection.

The simplest lesion is the solitary fairly-well-localized solid shadow, the abscess. As softening occurs with drainage into the bronchi, clear areas appear either as single or multiple cavities. The larger and older cavities frequently have a fluid level. As the lesion disappears the cavity grows smaller, the surrounding tissue less dense with only a faint irregular shadow remaining representing the connective tissue scar. If the lesion is progressive the abscess is less clearly defined, spreading upward and downward as a diffuse fuzziness which later becomes denser, while the original focus may be unchanged or may even show signs of clearing. In gangrene the shadows are more diffuse with rapid cavitation in several places and progressive involvement of new areas. Usually an entire lobe or even the entire lung is involved in gangrene.

In bronchiectasis the lesions are not easily identified. The older cases reveal cavitations with some density about them due to fibrous tissue proliferation. The shadow from fibrosis is usually limited to the bronchi and the cavities. When fuso-spirochete infection sets in with the production of foul sputum, fever, leucocytosis, the shadows become more diffuse and may extend some distance away from the bronchi, into the periphery. Frequently these latter shadows clear in the center, forming cavities difficult to differentiate from the

original bronchiectatic dilatations. An exudate in the pleural cavity may obscure the lesion in the lung. Frequently the fluid is only serofibrinous from pure streptococcal infection, but when gas is found above the fluid the exudate is more purulent and putrid, due to fuso-spirochetal infection from an abscess perforating into the pleural cavity.

The occurrence of fusiform bacilli and spirochetes in these pulmonary cases suggested an additional mode of therapy that we employed in some patients. It has been recognized that salvarsan has an influence on the fuso-spirochete infection of Vincent's angina and gangrenous balanitis due presumably to the spirocheticidal action of the drug. In several lung cases the results with neosalvarsan therapy were so striking that one might attach a specific effect of the arsenicals upon fuso-spirochetal pulmonary infection. In all of the cases but one the Wassermann reaction was negative. It should be remembered that the spirochetes concerned in this lesion are not the spirochetes of syphilis but morphologically identical with those seen in the normal mouth, and in Vincent's angina. Indeed, from our studies we have been led to conclude that the reports of various authors in interpreting solid infiltrations as syphilitic on the basis of a positive Wassermann and clearance of the lesion under specific therapy are misleading; that the lesions they describe correspond to those we have observed due to fusiform bacilli and spirochetes; that the syphilis was coincident; furthermore, the clinical picture in their cases, as in ours, was usually one of suppuration and necrosis with the production of foul sputum.

The following cases of a series of forty patients with fuso-spirochete infection are cited as illustrating the different types of lesions.

Case 1. Lung abscess, following ether anesthesia. S. Y., 48, male. History is of a herniotomy under ether anesthesia, followed by pulmonary symptoms and foul sputum expectoration, within fifteen days. Two weeks later he entered hospital with pain in chest, physical and X-ray findings of pulmonary abscess in right lung (Fig. 1). The sputum was foul, forming three layers on standing. Smears revealed many

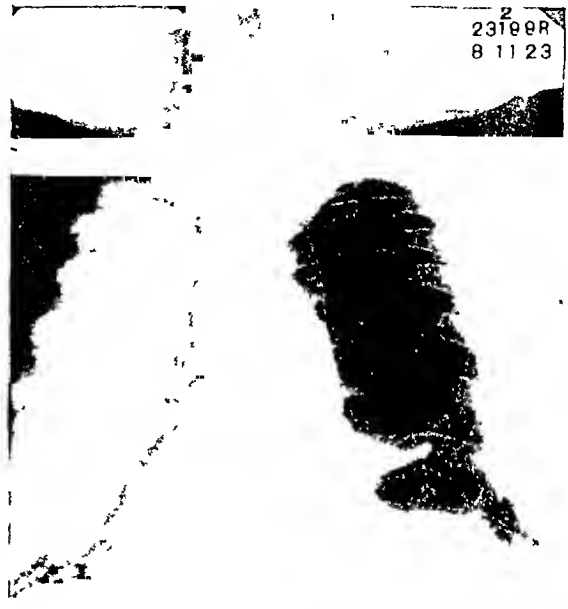

Fig. 6. Case 4, four weeks later, after neosalvarsan therapy.

fusiform bacilli and spirochetes and streptococci.

Case 2. Multiple abscesses of the lungs. C. M., 50, white, male. In history obtained, the pulmonary symptoms of cough, pain followed injury to back by falling iron door one week previously. One week later he developed foul expectoration. On physical and X-ray examination one month later, he presented signs of marked involvement of right lung with the formation of multiple abscess cavities, some of which may have been bronchiectatic (Fig. 2). Sputum daily measured about 300 c.c., was foul, formed three layers, and on smear revealed fusiform bacilli, spirochetes and cocci.

Case 3. Pulmonary gangrene following ether anesthesia. J. P., 32, male, history of pain, cough, foul expectoration two

weeks after an appendectomy for chronic abdominal pain. General symptoms of fever, loss of weight set in, followed by a rapid, progressive course with physical and X-ray evidences of extensive involvement of right lung (Fig. 3). The sputum became very putrid, green, and liquid. Smear revealed numerous fusiform bacilli, spirochetes, streptococci and a few gram negative bacilli. No tubercle bacilli were present.

Case 4. Pulmonary abscess, with neosalvarsan therapy. J. D., 52, white, developed cough, foul expectoration following no definite cause. On physical and X-ray examination, he presented involvement of left lower lobe with cavitations (Fig. 4). Sputum revealed fusiform bacilli, spirochetes and streptococci. He was placed on neosalvarsan therapy. Improvement was immediate and rapid, with shrinking cavitation in a week (Fig. 5), normal pulse and temperature. In four weeks lesion had almost completely disappeared (Fig. 6).

CONCLUSIONS

In pulmonary lesions, particularly abscess, gangrene and bronchiectasis with the production of foul sputum, the putrid character is usually the result of infection with fusiform bacilli and spirochetes; these organisms resemble in their morphology those found about normal teeth and tonsils and in Vincent's angina.

The diagnosis, course and the influence of salvarsan on these lesions are most readily studied by the X-ray.

Solid infiltrations of the lung, incorrectly called syphilitic because of clearance under salvarsan therapy, are usually fuso-spirochetal infections, which respond to specific therapy.

DISCUSSION

Dr. E. C. Rosenow (Rochester, Minnesota): In discussing this splendid presentation I want to emphasize just a few points. In this work symptoms and characteristic lesions are due to a uniform mixture of micro-organisms. The results are extremely important because they supply information which should lead to the prevention, at least in many instances, of lung abscess following this type of pneumonia. Pathologists are realizing more and more that there is a certain type of pneumonia, believed to be due to aspiration, that tends to go on to abscess formation and gangrene. Dr. Pilot has demonstrated quite conclusively that these cases are the result of a mixed infection of streptococci, fusiform bacilli and spirochetes.

My own observations that might support the results of this work are illustrated by results in two cases, both of acute gangrenous appendicitis. In one, the appendix at operation was found to be already ruptured, with a large amount of foul-smelling pus present. The appendix was removed and a drainage tube inserted. The patient developed a septic fever, and ultimately succumbed. Marked infiltration of the retroperitoneal region, abscess of the lung, and metastatic abscesses, containing foul-smelling pus, in various parts of the body were found at necropsy. In the pus from the lung and from the metastatic abscesses we found diplococci and fusiform bacilli. The close relationship between the organisms was illustrated by the fact that very often the coccus forms of diplococci appeared to grow within the fusiform bacilli. Moreover, morphologic evidence was found that the fusiform bacillus might become a spirochete, and *vice versa.*

The other case was that of a patient with Vincent's angina, who about a week after the height of the attack developed acute appendicitis. A gangrenous appendix was found, which was removed within twenty-four hours of the onset of symptoms. I isolated a mixture of fusiform bacilli and streptococci from the throat as well as from the appendix, and with the mixture produced appendicitis on intravenous injection into rabbits. Sections of the appendix of the patient and of the rabbits revealed both streptococci and fusiform bacilli in the lesions. In this instance elective localization occurred with a mixture of micro-or-

ganisms similar to the mixture reported by Dr. Pilot.

DR. ISADORE PILOT (closing): I would be inclined to be rather conservative because of the small number of cases that we have encountered in our studies as the result of pneumonia. Most of the abscesses and gangrenes we have seen are the result of ether anesthesia, and a few apparently without any previous inflammatory conditions. To start salvarsan therapy because of the persistence of the physical signs and evidences of no resolution before the development of a putrid sputum, is questionable. We are studying some of the unresolved pneumonias and have found that many of them are not the result of infection from anerobic organisms, but still are the pure streptococcus, or pneumococcus pneumonias. As a rule, if fusiform spirochete infection sets in, it is evidenced at least by the expectoration of small quantities of foul sputum, and if by carefully washing the sputum and examining for spirochetes these anerobas are found, then I believe salvarsan therapy can be instituted.

Technic of making urethrogram.—The technic in making a urethrogram consists in placing the patient in the dorsal position with the plate beneath the pelvis; then turning the patient toward the right so that the pelvis is tilted to an angle of 45 degrees with the horizontal. The Coolidge tube is centered over the symphysis pubis. The urethra is now injected with a 5 per cent emulsion of silver iodide by means of a large hand syringe. When it is evident that the emulsion is entering the bladder, the exposure is made, care being taken to continue the injection during the entire time of exposure. In this manner, the anterior urethra, bulb, and posterior urethra can be clearly shown. If the injection is not made during the entire time of the exposure, the posterior urethra can not be shown, because, normally, it is held in a state of tonic contracture and closure throughout its entire length. The normal urethrogram shows that the anterior urethra is an expansile tube which maintains a regular and even contour during distention; the bulbous portion is the most elastic and usually dilates markedly before the opaque medium enters the posterior urethra. The latter always appears as a narrow shadow which leads up to the base of the bladder. By first filling the bladder with the opaque medium and then making the urethrogram, the outline of the entire lower urinary tract can be shown in the roentgenogram.

Certain precautions should be observed when using this method. It is contra-indicated immediately after cystoscopy. Too much force should not be used in injecting the medium because of the danger of extravasation from a diseased urethra.

As a diagnostic procedure it is particularly valuable to the urologist in cases of stricture where the urethroscope can not be used, because it will show the location, extent and number of strictures. It is also useful in demonstrating the direction and extent as well as the number of perineal urethral fistulæ. Diverticula of the urethra can be plainly shown. Roentgenographic shadows in the region of the vesical outlet are sometimes difficult to localize with reference to their situation in the bladder, posterior urethra or prostate. These shadows can be accurately localized by means of the cysto-urethrogram.

The article is illustrated with a diagram showing the position of the parts in making a urethrogram: and with nine urethrograms of the normal and pathological urethra.—*Roentgenology of the Male Urethra: Notes on the Anatomy, Physiology and Pathology. V. G. Burden. Surg., Gynec. and Obstet., March, 1924, p. 403.*

EDITORIAL

MID-ANNUAL MEETING

Chicago, Illinois, June 6 and 7.
Headquarters: Sherman Hotel

Local Committee

Dr. I. S. Trostler, Chairman
Dr. M. E. Hanks — Dr. M. J. Hubeny
Dr. B. C. Cushway — Dr. B. H. Orndoff

THE ANNUAL MEETING

The next Annual Meeting of the Society is to be held December 8 to 12 inclusive at Kansas City, Missouri. Headquarters will be at the Muehlbach Hotel.

Local Committee

Dr. E. H. Skinner, Chairman

Hospitality—Dr. O. H. McCandless, Dr. W. W. Duke.
Scientific Exhibits—Dr. Clyde Donaldson, Dr. Ira H. Lockwood.
Commercial Exhibits—Dr. L. C. Allen, Dr. David S. Dann.
Hall Committee—Dr. E. R. DeWeese, Dr. J. T. Swanson.
Hotel Committee—Drs. E. B. Knerr, W. T. McDougall, and Chas. E. Virden.
Hospital Clinical Committee—Dr. L. A. Marty, Dr. J. L. McDermott.
Liaison Committee—Dr. Geo. Knappenberger.
Publicity Committee—Dr. Geo. Knappenberger.

BASAL METABOLISM

The basal metabolic rate when accurately determined and its significance correctly appraised is of immense help both in diagnosis and in determining the progress and course of thyroid diseases. Over- or under-activity of the thyroid gland produces marked changes in the level of the basal metabolic rate because the secretion of the thyroid gland (the active principle of which is thyroxin) is a catalyst that accelerates the rate of heat production in proportion to its concentration in the body. It is not correct, however, to assume that all variations in the basal metabolic rate necessarily represent primary changes in the activity of the thyroid gland. For example, in leukemia the metabolism is usually markedly increased and in under-nutrition it is as a rule decreased. In certain cases of mental unrest or uneasiness the metabolism as obtained is considerably above the average normal, not because there is a technical error but because in that individual it is at first impossible to obtain the test under the standard condition of mental as well as physical rest, although after repeated determinations it is usually possible to obtain a basal rate and this will be found to be in most cases normal. It is impossible to do repeated determinations on all patients and it rests, therefore, on the clinical experience and acumen of the physician to select those cases for more intensive study which are likely to fall in this group. Unfortunately these patients simulate in some ways patients suffering from either adenomatous goiter with hyperthyroidism or exophthalmic goiter. Mistakes, therefore, can be easily made both in diagnosis and in judging the effect of treatment by a blind reliance on basal metabolic rate determinations.

At the present moment radiologists are intent upon studying the effect of X-ray therapy on exophthalmic goiter. Frequently a decrease in the basal metabolic rate following such treatment is presented as evidence that there has been a corresponding clinical improvement. This is justifiable only if the determinations are technically correct and are truly representative of the basal or standard metabolism of that individual both before and after treatment.

Walter M. Boothby, M.D.

WHY IS A ROENTGEN LABORATORY?

Why do we call the places where we do our work "roentgen laboratories"? They are no more laboratories than we are labo-

ratory workers or technicians. The rooms in which we place the various pieces of apparatus and go through the various procedures by which we make our roentgen examinations or administer roentgen or other treatments should not be so designated any more than we should be called "laboratory technicians."

Laboratories, as such, have to do with the manufacture, examination or manipulation of inert, impersonal, and material things, while our work involves the diagnosis, examination and treatment of animate, living human beings.

Do we ever hear an artist's work room called a "laboratory"? Do photographers speak of their "laboratories"? Do surgeons perform their operations in "laboratories"? Then why should we use the term "roentgen laboratory"? Does it add prestige to our specialty? Does it lend dignity to our guild? On the contrary, it tends to lower our standing and to reduce the prestige of our specialty with both the laity and with the other members of the medical profession.

Let us remember that we are physicians first and specialists afterwards; that we are exponents of the noble art of healing first, last and all the time. Let the laymen technicians conduct laboratories if they will, but let us conduct our practices in operating rooms where the science of roentgenology (or radiology, if you prefer) is applied for the diagnosis and treatment of disease. Let us discard the term "laboratory" in connection with our work and substitute a more correct and dignified term such as "office," "operating room," or "operating suite."

I. S. TROSTLER, M.D.

NEW DEPARTMENT OF RADIODONTIA

We are pleased to announce to the readers of this journal the establishment of a Department of Radiodontia. With the newer knowledge of the intimate relation between dentistry and general medicine the value of such a department is obvious. Although the majority of radiologists are physicians, many of them are devoting at least some of their time to the dental aspect of the specialty. Accordingly, a few pages each month given to this branch of the work will be of special interest to them and may be of benefit to members of the dental profession. That the time is opportune for the establishment of this department is indicated by the following citation from an editorial entitled "Dental education and medicine" in the *Journal of the American Medical Association* for March 29, 1924:

"Dentistry has become something far greater than mere tooth technology. It occupies an important position in preventive medicine and public health. President Pritchett has stressed the fact that to-day the dentist and the physician should stand on a plane of intellectual equality and be able to 'talk the same language.' The practice of medicine and the practice of dentistry, he writes, are coördinate divisions of health service. They are like trees that sprout spontaneously from an old stump, the stump having long since disappeared, trees alike in kind and closely similar in appearance, growing somewhat divergently from the same roots in a common soil, through the same air of freedom and individual opportunity, in the same light, toward the sky."

Arrangements have been made with Dr. Boyd S. Gardner, Chief of the Section on Dental Surgery of the Mayo Clinic, to edit this department, and it is his intention to devote at least four pages exclusively to short papers and case histories dealing with the problems common to dentistry and radiology. The Department of Radiodontia will appear first in an early issue of RADIOLOGY and will speak for itself thereafter.

Coming meeting.—The Western section of the American Roentgen Ray Society and the Pacific Coast X-ray Society will hold a combined meeting in Seattle and at Mt. Rainier, July 21 to 24.

The Executive Secretary of the American College of Radiology calls attention of the Fellows to the fact that the convocation of

the College has been changed to Wednesday, June 11, 1924, at the same time and place as originally named (The Drake Hotel, Chicago, 7 P. M.). President Pusey, of the American Medical Association, has called attention to the fact that Tuesday evening, June 10th, is the date of the official opening of the American Medical Association, hence the change.

A new cellulose acetate film has been placed on the market by an American firm, to replace the celluloid film, its introduction being in answer to the demand among roentgenologists for a film of a non-inflammable nature.

SIR ARCHIBALD DOUGLAS REID

To Sir Archibald Douglas Reid, who recently died in Switzerland at the age of fifty-three, the science of roentgenology and the organization of roentgenologists owe grateful memory. Largely through his efforts British radiologists grouped themselves into the British Institute of Radiology, from which it was his dream that an International Institute of Radiology should be the eventual outgrowth.

In the first year of the World War, when England had practically no organized X-ray service for the Army, Sir Archibald Reid was named President of the War Service X-ray Committee, and accomplished the tremendous task of providing equipment and choosing personnel for the several British fronts—in the East as well as on the European battlefields and in the base hospitals.

He held office in all the British societies for the advancement of roentgenology, and was an Honorary Member of the American Roentgen Ray Society. Since 1911 he had been Superintendent of the Radiological Department of St. Thomas' Hospital, and to his numerous other activities he added the publication of various original papers and translations. Sir Archibald Reid had a genius for organization, had acquired profound knowledge of his specialty, and was a man of charming personality.

BOOK REVIEW

RADIUM REPORT OF THE MEMORIAL HOSPITAL, NEW YORK, *Second Series, 1923, 19 Chapters, 305 Pages, 55 Illustrations, Numerous Analytical Tables. Paul B. Hoeber, Inc., New York. Price $5.00.*

The second series (1924) of this American radiotherapist's bible is ready. The apostles who contribute include the leonic Ewing, the incisive Quick, the enthusiastic Lee, the bombastic Bailey, the persistent Barringer, the babsonic Stone and other departmental workers upon the Memorial Hospital Staff. There is a revised posthumous article by the revered leader, H. H. Janeway.

That inspirational leader, Janeway, provides the first chapter upon the Status and Scope of Radium Therapy at the Memorial Hospital and the second upon the Technical Principles used there.

Dr. Douglas Quick furnishes the next five chapters under these titles: Malignant Tumors of the Intraoral Group; Carcinoma of the Rectum; New Growths of the Parotid Gland; New Growths of the Eyeball and Orbit; Malignant Tumors of the Skin. Most of these articles are amplifications of articles which have been published in certain American radiologic journals.

Dr. Harold Bailey and co-workers—Edith Quimby, Halsey J. Bagg, and William P. Healy—have three chapters upon Radium in Cancer of Female Generative Organs; Vulval and Vaginal Cancer; Follow-up Results of 908 Cases of Uterine Cancer Treated with Radium. Bailey promotes and defends his bomb method of irradiation to the parametrium. Bailey continues to insist upon the necessity of a large dosage directed toward the parametrium from a vaginal anchorage in addition to the intra-cervical and intra-uterine radiation. In view of the great number of uterine malignancies being treated throughout America by the latter method alone, it will be interesting to parallel case reports some years hence.

Burton J. Lee takes three chapters to describe technic and results in breast irradiation. Barringer provides four chapters upon Radium Therapy of Prostatic Carcinoma, Bladder Carcinoma, Teratoid Tumors of the Testicles and Epithelioma of the Penis.

Dr. William S. Stone, Clinical Director of Memorial Hospital, has a summarizing chapter which has already been published. The crowning chapter is the Muetter Lecture (College of Physicians, Philadelphia), by Dr. James Ewing, upon "An Analysis of Radiation Therapy in Cancer." This analytical dissertation should be studied by every radium therapist. Its contained knowledge will help anyone in the clinical appreciation of prognosis in cancer types. Every pathologist working with irradiated tissues should attempt to know what Ewing offers so freely and honestly.

We predict a heavier sale of this book than any previous radium volume. It should be translated for our foreign friends. The methods employed in displaying technic and recording histories and analyzing results are models of conservatism and scientific honesty. The general profession, through appreciative radiologists, is indebted to the several authors for the sacrifice and patience demanded in producing these reports. The persevering publisher, Hoeber, should also have his measure of praise for the typographical excellence and neatness of the finished product.

E. H. Skinner, M.D.

HOT SPRINGS MEDICAL INTELLIGENCE BUREAU

A Medical Intelligence Bureau for Hot Springs, Arkansas, has been organized under the auspices of the Garland County Medical Society and local Chamber of Commerce. Hot Springs National Park is owned and controlled by the United States Government, and the Medical Intelligence Bureau is in charge of Colonel L. Mervin Maus, Medical Corps, U. S. Army, Retired.

The purpose of this Bureau is to extend to the medical profession of the country, general and special information relative to the uses and virtues of the waters of the Hot Springs National Park in the treatment of diseases and morbid conditions as proven by observation and experience during a period of more than a hundred years.

While it is believed that the major portion of the profession has no definite knowledge of the beneficial results to be derived from the use of these waters, it is understood that an unfavorable opinion is current among many physicians in regard to the efficacy of the waters as a therapeutic agent, the character of the visiting clientele, and the possibility of venereal infection, while taking the baths at Hot Springs. These and other prejudicial reports have seriously operated against the popularity of Hot Springs as a health resort, and have materially diverted the patronage of the public to other resorts of less merit.

It is believed that, not only can such erroneous impressions be removed through the well-directed propaganda of the Medical Intelligence Bureau, but that the profession at large can be convinced as to the advisability of transferring thousands of suitable cases to these springs, where relief and cure can be reasonably expected.

PROGRAM OF THE RADIOLOGICAL SOCIETY OF NORTH AMERICA. CHICAGO, JUNE 6-7, 1924

Friday, June 6th, morning session, 8:30 A. M.

1. A. Mutscheller, Ph.D. (by invitation), New York—"Average Wave Length of X-rays."

   Voltage and current measurements with sphere gaps and milliampere meters may result in very large errors. Determinations from measurements upon the radiation, of the current filter thickness, the average wave lengths and the transmitted useful component are safe and dependable. Average wave length is

defined and its relation to therapeutic effects is discussed.

2. Dr. Byron C. Darling, New York—"The Sacro-iliac Joint: Its Diagnosis as Determined by the X-ray."
3. Dr. George F. Thomas, Cleveland—"Injuries About the Wrist."

The relative frequency and importance of the more common injuries about the wrist, based upon analysis of cases from the author's own records.

(a) Anomalies and other sources of misinterpretation.

(b) The dependence of functional result upon anatomical relationship.

(c) The function of the roentgenologist in diagnosis and treatment.

4. Dr. Bundy Allen, Iowa City, Iowa—"Pathological Fractures."
5. Dr. Howard P. Doub and Dr. C. W. Peabody, Detroit—"Generalized Osseous Dystrophies, with Reported Cases."
6. Dr. H. W. Meyerding, Rochester, Minn.—"Radiographical Types of Bone Sarcoma."
7. Dr. John T. Murphy, Toledo, Ohio—"Adamantine Epithelioma."

Discussion opened by Dr. Joseph C. Bloodgood, Baltimore, Md.

8. Dr. Robert G. Allison, Minneapolis—"Bone Findings in Chloroma."
9. Dr. W. Warner Watkins, Phoenix, Arizona—"The Ethics of the Commercial X-ray Laboratory."

Dr. M. A. Loebell, Zanesville, Ohio—Five-minute lantern slide demonstration of a neat and original method of marking X-ray plates.

Afternoon session, 1:45 P. M.

10. Dr. M. J. Sittenfield, New York—"Present Studies in Experimental Cancer."
11. Dr. Harry H. Bowing, Rochester, Minn. — "Significant Cellular Changes Observed in Irradiated Tissue, with Special Reference to Rectal Carcinoma."

Discussion opened by Dr. Henry Schmitz, Chicago.

12. Prof. C. M. Child (by invitation), University of Chicago—"Quantitative Factors in the Susceptibility of Living Cells to External Agents" (lantern slides).
13. Maud Slye, Ph.D., Chicago—"Some Aspects of a Future Preventive Medicine on the Basis of the Facts of Heredity."
14. Dr. George E. Pfahler, Philadelphia—"A Case of Malignant Degeneration in Radiodermatitis Successfully Treated by Electrocoagulation and Skin-grafting."

Patient operated upon in 1908. Enlargement of metastatic glands in axilla and supraclavicular region two months later, followed by heavy X-ray treatment.

Malignant degeneration of the sclerotic areas (1917), nine years after original operation.

Destruction of the malignant disease by electrocoagulation.

Patient still well (1924), sixteen years after operation.

15. Dr. Russell D. Carman, Rochester, Minn.—"The Occupational Hazard of the Radiologist, with Especial Reference to the Blood Changes."
16. Dr. C. A. Simpson, Washington, D. C.—"X-ray Treatment of Hyperthyroidism."

"Twelve years' experience in over 200 cases of hyperthyroidism convinces me that radiating the thymus gland along with the thyroid is very important.

"(1) Some complete surgical failures can be symptomatically cured by radiating the thymus alone. The percentage of failures from X-ray is apparently little greater than of failures following surgical operation.

"(2) The danger of producing a hypothyroid condition by a gradual atrophy of the gland over a period of months is not as great, nor does it produce the amount of shock to the patient, as does the surgical removal of a questionable-sized por-

tion of the thyroid gland at a single operation.

"(3) Early cases of hyperthyroidism respond to X-ray therapy much quicker than late ones. After removal of focal infections, all symptoms may continue and not subside until X-ray is employed.

"(4) The effect of Lugol's solution is temporary and it should be employed in the early weeks of X-ray therapy, while waiting for the atrophic effect of X-ray. Its popularity should increase the usefulness of X-ray in hyperthyroidism.

"(5) With such a technic, I believe few cases of hyperthyroidism will need, or should face, the dangers of a surgical operation."

17. Dr. C. H. Nims, Hot Springs, Ark.— "Deep Therapy Simplified."

18. Dr. H. J. Ullmann, Santa Barbara, Calif. — "The Management of the Inoperable Cancer Patient."

Heartlessness of refusing treatment because no hope of cure, when symptoms may be alleviated. Value of radiotherapy when properly adapted to patients. Necessity of careful diet. Regulation value of dietary management worked out at Cottage Hospital.

Friday evening, June 6th

Sherman Hotel—Mid-annual Banquet
It is hoped that all members, visitors and exhibitors will attend.

Saturday, June 7th, morning session

19. Dr. T. A. Groover, Dr. A. C. Christie, and Dr. E. A. Merritt, Washington, D. C.

"Pulmonary Tuberculosis as a Cause of Pain in the Shoulder."

20. Dr. I. S. Trostler and Dr. Robert H. Hayes, Chicago — "Pathognomonic Radiographic Findings in Early Tuberculosis."

21. Dr. John D. MacRae, Asheville, N. C. —"The General Aspect of Tuberculosis as Presented by X-rays."

22. Dr. L. R. Sante, St. Louis—"Miliary Tuberculosis: Radiographic Evidence of Chronic and of a Healed Form."

The report is based on the observation of 12 cases of miliary tuberculosis —age of patients—mode of onset—course and duration of disease—evidence of a chronic form—is the disease invariably fatal? — evidence suggestive of a healed type of miliary tuberculosis.

Discussion opened by Dr. Edward S. Blaine, Chicago.

23. Dr. Herbert M. Rich (by invitation), Detroit — "Classification in Lung Abscess with Regard to Treatment."

24. Prof. Arthur H. Compton (by invitation), University of Chicago—"The Mechanism of Ionization by X-rays."

25. Dr. Evarts A. Graham and Dr. W. C. Cole (by invitation), St. Louis— "The Roentgenological Visualization of the Gall Bladder by the Use of Intravenous Injections of Calcium Tetrabromphenolphthalein." (Lantern slides.)

26. Dr. Amedee Granger, New Orleans— "New Device and Technic for Making Radiographs of the Mastoids in the Law and Arcelin Positions."

A much simplified technic. The very simple device makes it possible to make exposures of the two mastoid regions on one 8x10 film, so that the mastoid regions are not only symmetrical, but quite on a line.

27. Dr. K. S. Davis (by invitation), Rochester, Minn. — "Intrathoracic Changes as a Result of Roentgen Therapy: A Clinical and Experimental Study."

Review of the literature, with a presentation of a few selected cases to bring out the salient points in the clinical and roentgenological findings. A large part of the paper is

made up of a report of the gross and microscopic findings in animals, which had received intensive roentgen therapy over a period of many months, and an attempt to correlate these findings in the interpretation of the clinical evidence in those cases which show changes as a result of roentgen therapy.

Afternoon session, 1:45 P. M.

28. Dr. Henry Schmitz, Chicago—"The Treatment of Surgical Tuberculosis by Quartz Light and X-rays."
29. Dr. Leon J. Menville, New Orleans—"Experimental Work Showing that the Roentgen Rays and Radium Rays do not Kill and Apparently do not Affect the Viability of Tertian Malaria Parasites (Plasmodium Vivax) *in Vitro.*"
30. Dr. I. Seth Hirsch, New York—"Cancer of the Lung: A Clinical Roentgen Study."
31. Dr. L. T. LeWald, New York—"Right-sided Diverticulitis."
32. Dr. C. C. Grandy, Fort Wayne, Indiana—"Clinical Roentgenology."
33. Dr. Lewis Gregory Cole, New York—"Results of Medical Cures of Gastric Ulcers." (Moving films illustrating motor phenomena of stomach, sphincter and cap.)
34. Dr. W. O. Upson, Battle Creek, Mich.—"Phytobezoar of the Stomach."
35. Dr. William L. Clark, Dr. J. Douglas Morgan, and Dr. E. J. Asnis, Philadelphia—"Preliminary Report on a Modified Fractional X-radiation Technic."
36. Dr. F. P. Boswell, Montgomery, Alabama—"The X-ray Treatment of Acne."

Radiological Society excursion on SS. *Manitou* to Mackinac Island. Return Monday evening.

ABSTRACTS OF CURRENT LITERATURE

Experimental production of cancer. — The investigations reported in these three papers led to experiments, some of which, even previous to the war, had brought forth results which had aroused considerable attention, when Fibiger in 1912, by the administration of a cockroach spiroptera neoplastica, Yamagiva and Ohno in 1914, by means of scarlet red oil, and also Ichikawa and others, by means of tar, succeeded in the experimental production of cancer in laboratory animals. Some of the subsequent experiments were confirmatory of the former findings, while others failed to yield the same results, so that to a certain extent there was a tendency to accept individual and racial differences as playing a decisive part in the success or failure of the experiments.

[It would be interesting to carry on similar experiments with Dr. Maud Slye's mice which have an inheritable or inherent predisposition to cancer, as well as with those which are immune against spontaneous tumors.]

The papers mentioned above, report experiments, in which changes were brought about by the action of tar, at the site of junction of two different types of epithelial tissue, such as at the rectum and anus, as well as those in which a tumor genesis was produced by the action of tar absorbed from the intestines.

Since the changes brought about on the pre-stomach of these animals by the administration of thallium were of a similar nature, they will also be reported at this time.

Results: (*a*) At the site of action of the tar, e.g., the rectum, the mucosa always remained entirely unchanged, the dermis only showing circumscribed areas of loss of hair with atrophy of the hair follicles. (*b*) Remote effects due to absorption. In a number of animals (40 per cent) changes were found in the pre-stomach similar to those described by Fibiger in his experiments, mentioned above. There were found hypokeratoses, ranging from a merely superficial callus formation to a state of complete hornification of the organ, a condition which has been designated by the authors as "malignant hyperkeratosis," because the animals perished in consequence of the changes brought about, and the impossibility of food assimilation conditioned thereby. The fact must be duly emphasized, that the malignant degeneration of the mucosa, in the sense of a carcinoma, has never

been found, so that the above statement may be misleading. The authors therefore say, "The process is an inflammatory tumor-like epithelial overgrowth, with an exceptionally marked hyperkeratosis, confined exclusively to the pre-stomach of such animals as were already known to be predisposed to such changes."

In the experiments carried on with thallium, such findings were observed in 80 per cent of the animals, and in some cases the changes were more marked than those brought about by the experimentation with tar.

The question as to the manner in which tar acts as an etiological factor can only be answered by suppositions. In regard to the experimentation with thallium, it is assumed that the vegetative nervous system is the central point of attack, and that the subsequent changes are brought about via the endocrine system, since, according to former experiments which have recently been confirmed, concomitant developmental .disturbances, loss of hair, cataract, sexual insufficiency and osteomalacial bone processes, are also produced. Sternberg, by means of application of tar preparations, which are used for therapeutic purposes at the dermatological clinic at Frankfurt, was able to produce three indisputable carcinomata, two of which showed lung metastases, which were histologically identified.

HANS A. JARRE, M.D.

"Tumor-like Changes in the Mucosa of the Pre-stomach of Rats, Due to the Action of Tar" (A. Buschke and E. Langer) and "Epithelial Overgrowths in the Pre-stomach of Rats, Produced Experimentally by the Action of Thallium" (A. Buschke and Bruno Peiser). (Both experiments were carried out with the assistance of the Research Institute of Cutaneous Diseases, Philadelphia, Dr. Schamberg.) Zeitschrift für Krebsforschung, XXI, No. 1. "Contributions to the Experimental Production of Cancer by Tar" (A. Sternberg), ibid., XX, No. 6.

"Rous tumors."—Former experiments led to the conclusion that certain sarcomata in chickens, which are often named after the New York scientist, Rous, are capable of being transmitted by cell-free body fluids and juices expressed from tissue. Jung investigated the possibility of these transmissions due to the vaccination with cells, cell remnants, nuclei or nuclear constituents, which were passed through filters. He carried on very careful experiments with different kinds of filters, including those with a pore width of 0.6 μ. He believes that, contrary to the hitherto accepted opinions cited above, the possibility of transmission by cells or cellular constituents must be taken into consideration, e.g., by means of viable fragments of crushed or broken-up cells, or by nuclear constituents, chromatin material of anaplastic cells, the extraordinary resistive capacity reproduction of which is supposed to be present even in the smallest fragments which pass through the finest filters.

In the light of this knowledge, Teutschlaender again gives another very critical consideration as to the place in pathology of the enigmatical "Rous tumors." In regard to their transmission the following possibilities must be considered:

(1) Ordinary tumor-cell transplantation,
(2) Sub-cellular transplantation—
  (*a*) In the form of transmission by parts of cells, which themselves present a biological entity.
  (*b*) By the transmission through cell fragments which are capable of subsequently forming cells.
(3) A virus, which may belong to the group of invisible filtrable viruses—chlamydozoen,
(4) A chemically specific substance characteristic of the body, which again stimulates the mesenchymal cells of the vaccinated animal to the formation of the same substance.

The question cannot be definitely answered, because, with the experimental evidence so far available, the decision as to the possibility of transmission by chlamydozoen, or by cells or cell fragments, cannot be made. The value of the work lies, as the author himself expresses it, in the following statement:

"In presenting for discussion the possibility of a relatively specific symbio-cellular infection in the case of the chicken sarcoma to my professional colleagues, who in general are opposed to the parasitic theory in any form, I was not so much concerned with the chlamydozoen hypothesis, as to show them that, since the usual arguments cited against the acceptance of chlamydozoen infection do not stand the test, a one-sided emphasis of one point of view only, in regard to the etiology of tumors, especially of the heterogeneous group of sarcomas, is not justified, without due consideration." Had it not been for the assumption of the parasitic theory, experiments in regard to the cell-free transmission of tumors would never have been attempted.

Berger's work is concerned with the therapeutic possibilities of these tumors, and continues along paths which have long been followed. Material for treatment is obtained by grinding and centrifuging tumor tissue and inactivating the supernatent part by exposing it to a temperature of 60 C. for 15 minutes. The fluid thus obtained, which is slightly opalescent and cloudy, is used for vaccination in quantities of from two to five c.c. or even more. These experiments proved that the growth of an implanted tumor could never be prevented by simultaneous vac-

cine treatment. On the other hand, the life of the different animals could be prolonged and the appearances of metastases prevented. In one case it was possible to cause a total retrogression of a tumor of considerable size, with the formation of a scar, while other animals perished with apparently toxic manifestations, caused by the degeneration of the tumor in consequence of the treatment. The more specific the treatment, the more rapid was the destruction of the tumor caused thereby and the more severe the intoxication. The next task lies in the attempt at discovering really effective curative measures, which would not cause concomitant toxic lethal manifestations.

HANS JARRE, M.D.

"Considering the Influence of Inactivated Tumor Material on the Growth of Transmissible Sarcoma in Chickens" (Erwin Berger), "Examination for the Presence of Cells in the Membrane Filtrate of Transmissible Sarcoma in Chickens" (Gustave Jung) and "Concerning the Biology of Any Transmissible Chicken Sarcoma" (Teutschlaender). (Three papers from the Institute for Experimental Cancer Research in Heidelberg.) Zeitschrift für Krebsforschung, XX, Nos. 1 and 2.

Chronic myelogenous leukemia treated by radium.—Remissions occur normally in chronic myelogenous leukemia, or may be brought about by benzol, X-rays or radium. The most satisfactory remissions have been obtained through the use of radium. Although the remissions may last for months or years, there is always a recurrence and subsequent remissions are increasingly difficult to obtain.

In five cases reported. radium bromide was used, 100 mg. raised 1 inch from the surface, screened by 1 mm. of lead, the area over the spleen being divided into 2-inch squares, each area receiving 300 milligram hours. Very satisfactory temporary remissions were secured in all the cases. although one developed an acute leukemia, and died.

Radium is the most satisfactory agent in the treatment of chronic myelogenous leukemia.

W. W. WATKINS, M.D.

The Radium Treatment of Chronic Myelogenous Leukemia. I. A. Bigger, Jr. Va. Medical Monthly. Nov.. 1923. p. 543.

Post-typhoid condition.—The author reports the case of a man. 36 years of age. who complained of pain in his back. following an attack of typhoid. Occasional fever was present. A roentgenogram made one year later showed a fairly broad bridge-like bony connection between the third and fourth lumbar vertebræ. The Widal reaction was positive. As to the diagnosis, the author states that against spondylitis deformans, one should bear in mind, first, the age and history (no trauma—recent typhoid) and the combination of pains with fever and their localization to the musculature at the sides of the lumbar vertebræ. The solitary appearance of bone changes is also very noticeable, as well as the productive character with the formation of a solid bone bridge between two vertebræ, the latter being quite different from those of tuberculous spondylitis.

J. D. CAMP, M.D.

Another Case of Spondylitis Typhosa. Abraham Troell. Acta Radiologica, II, 1923, p. 509.

Electrothermic coagulation. — The new method is simply a development along previously well-known lines, with more precision in measurement, and at higher voltages, permitting a greater depth dose. Changes in technic have been made to conform to the new conditions.

Electrothermic coagulation is one of the most efficient methods of removing local lesions. Combined with radiation, it can be used to advantage in leucoplakia, cancer of the tongue, epitheliomata, bladder cancer through cystotomy opening, malignant tonsils and other locations about the mouth.

W. W. WATKINS, M.D.

The Treatment of Malignant Disease by Means of the New Higher Voltage Shorter Wave Length Roentgen Rays, Radium, and Electrothermic Coagulation. J. Thompson Stevens. Jour. of Med. Soc. of New Jersey, Dec., 1923, p. 415.

Colonic disease and the barium enema.—In the best clinics of this country, the barium enema is a part of the routine for nearly all abdominal pains. The normal colon differs markedly in the radiologic pictures and it is of importance that we recognize the normal colon. The barium enema is now being used to help in diagnosing cancer of the colon, diverticulitis of the colon, tuberculous colitis, chronic ulcerative colitis, polyposis of the colon, transposition, Hirschsprung's disease, and fistulæ of the colon.

W. W. WATKINS, M.D.

X-ray Examination of the Colon by Means of the Barium Enema. Leon J. Menville, M.D. New Orleans Med. and Surg. Jour., Dec., 1923, p. 284.

Endothermy in the destruction of neoplastic disease.—The development of electrothermic coagulation as a means of destroying cancer is sketched. The loose nomenclature surrounding all electrical or high frequency therapy is pointed out. For the sake of clearness the writer has chosen new terms—endothermy—monopolar and bipolar—this expresses both phases of the

work and indicates its technic. Endothermy is the localized production of heat in the tissues from within in response to the many oscillations of a high frequency current and it is always executed with a sharp-pointed active electrode. It is the purpose of this paper to outline the accomplishments of endothermy in the destruction of neoplastic disease. No one agency can be considered all-powerful — radium, X-ray, and surgery are all valuable and all have produced many cures. Endothermy, where it is applicable, however, gives very good, even at times better, results in the opinion of the author. Endothermy destroys the mass before removing it—a distinct advantage. In endothermy the active electrode is cold when applied—the heat is developed in the tissues from the resistance of the body to the passage of the current.

The three most important neoplastic diseases are tuberculosis, benign and malignant growths, and syphilis.

The technic followed in the treatment of these conditions is accurately outlined and many cases illustrative of this treatment are shown.

L. R. SANTE, M.D.

Endothermy in the Treatment of Accessible Neoplastic Diseases. George A. Wyeth. Annals of Surgery, Jan., 1924, p. 9.

Syphilis of the lungs.—The author briefly reviews the historical aspect and the previously reported cases. About 150 cases had been reported and his search of the literature of the last two years revealed 50 additional cases. This makes about 200 cases reported in the medical literature of the world. His own study is based on seven cases occurring among 11,982 medical admissions, an incidence of 0.05 per cent. Four of the seven cases were proved histologically and three by the most rigid clinical criteria.

The pathology of acquired syphilis of the lung may be classified in five types: gummata, chronic interstitial pneumonia, pulmonary sclerosis, syphilitic phthisis, and bronchopneumonia.

The author sums up the symptomatology by stating that the presence of a troublesome cough, moderate expectoration and occasional attacks of hemoptysis and chest pain in the absence of such constitutional symptoms as fever, sweats and loss of weight, should always suggest the possibility of the lung condition being of syphilitic origin and lead the clinician to investigate the patient's history more carefully and to have a blood Wassermann taken.

There may be no physical signs. In the majority of cases, however, the physical signs are very extensive and may suggest a pleural effusion, a thickened pleura, consolidation of the lung or even extensive cavity formation.

The roentgen rays invariably show some changes, even the cases without other physical findings. The author does not agree with Watkins, Golden and others as to the pathognomonic X-ray picture. It is true the picture is usually distinguishable from that found in pulmonary tuberculosis, owing to the unilateral tendency of the process, its greater liability to involvement of the roots of the lung rather than the apices, and the rarity of signs of calcification. According to Callender, the shadows are clean-cut and sharp and lack the mossy outline of tuberculosis, while others, as Watkins, emphasize the irregular borders of the syphilitic shadow and its relation to the hilum of the lung rather than to the bronchial tree. He agrees with Karshner that there is as yet no characteristic X-ray picture of syphilis of the lung, nor can one be expected from such a varied pathologic picture as syphilis offers.

In the diagnosis there are five points worthy of consideration: absence of any grave symptoms as fever, sweating, etc., constantly negative sputum, the presence of other stigmata of syphilis, a routine positive Wassermann, and the therapeutic test of antiluetic treatment.

In the author's experience the results of therapy have not been very gratifying. This was probably due to the fact that the cases were too far advanced to the stage of sclerosis and their resistance so lowered that they succumbed to some secondary infection. However, the success of antiluetic treatment in the gummatous form cannot be denied.

Complete protocols of the author's cases illustrated by microphotographs are presented and a comprehensive bibliography.

W. J. MARQUIS, M.D.

Pulmonary Syphilis. C. P. Howard. Am. Jour. of Syphilis, VIII, Jan., 1924, p. 1.

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